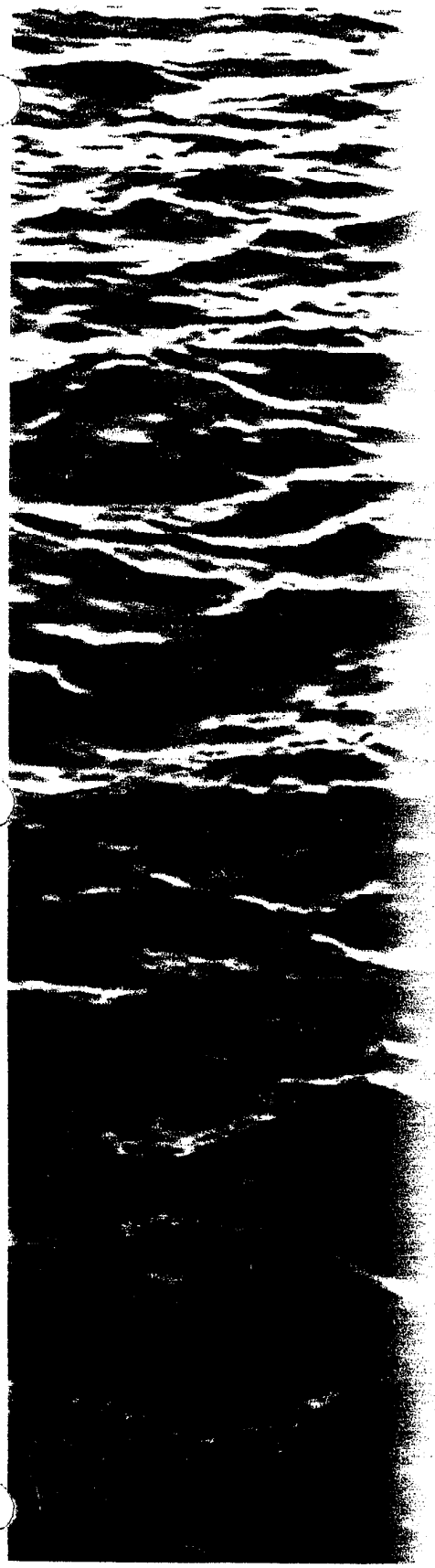

Navy Bank Surface Sediment Characterization Data Report

Prepared for:

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June 27, 2001

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EXECUTIVE SUMMARY

This document summarizes the nature and extent of surface sediment contamination of bank and side-slope areas adjacent to the Navy and Marine Corps Reserve property located on Alexander Avenue in Tacoma, Washington. Historical chemistry data from surface sediment samples collected in this general area indicate that such sediments contain elevated chemical concentrations, in excess of Commencement Bay Nearshore/Tideflats Sediment Quality Objectives (SQOs). However, the areal extent of the elevated concentrations could not be determined from the available data.

The bank and side-slope area along the Navy and Marine Corps Reserve property was characterized during two successive phases of the investigation. During Phase I sampling on February 16 and 17, 2000, sediment composite samples were collected from eight (8) grid sections, and all samples were submitted for physical and chemical determinations. Four (4) of the 8 samples collected during Phase I, including 1 intertidal and 3 intertidal grids, exceeded SQO chemical criteria. These grids were subsequently resampled during the Phase 2 investigation on June 5, 2000. The Phase 2 samples were submitted for confirmatory chemical analyses and bioassay testing. All data for this project are considered acceptable for use as qualified.

Based on the sediment sampling data described herein, all intertidal sediments within the Navy Bank area currently comply with SQO criteria, and thus do not require remedial action. In addition, two of the subtidal sediment sections located at either end of this area (Segments 1S and 4S; see Figure 1), were also determined to comply with SQO criteria, and do not require remedial action.

The two (2) subtidal sediment grids located within the center of the Navy Bank area, and immediately below the existing pier (Segments 2S and 3S; see Figure 1), exhibited minor biological effects during this study (above SQO criteria), but did not exceed severe effects criteria. Moreover, the maximum concentrations of chemical contaminants detected within this area are predicted to decline to well below the SQO criteria within a 10-year recovery period. Further, the natural recovery estimates are conservative, in that they do not account for new sources of clean sediment to this area that will result from the cleanup(dredging) of the adjacent waterway area.

Since dredging or capping of the Navy Bank under-pier area would be technically difficult, and would likely lead to impacts to the pier structure, and since natural recovery is expected to reduce chemical concentrations to below SQO criteria with a 10-year period following dredging of the adjacent waterway, monitored natural recovery is the recommended action within this area. Natural recovery in this case is consistent with the U.S. Environmental Protection Agency's Commencement Bay Record of Decision and Explanation of Significant Differences. Natural recovery monitoring of Navy Bank Segments 2S and 3S would occur during years 2, 5, and 10 following completion of remedial construction (i.e., dredging of the adjacent waterway). The natural recovery monitoring in this area would include analysis for all chemicals presently above SQO chemical criteria.

1 INTRODUCTION

Anchor Environmental, LLC (Anchor) and Conestoga-Rovers and Associates (CRA) were retained by the Port of Tacoma (Port) and Occidental Chemical Corporation (Oxy) to conduct a characterization of the sediment bank and side-slope areas adjacent to the Navy and Marine Corps Reserve property located on Alexander Avenue in Tacoma, Washington. Historical chemistry data from surface sediment samples collected in this general area indicate that such sediments contain elevated chemical concentrations, in excess of Commencement Bay Nearshore/Tideflats Sediment Quality Objectives (SQOs). However, the areal extent of the elevated concentrations could not be determined from the available data.

The sampling and analysis plan (SAP) prepared for this project describes all procedures followed during the collection and analysis of sediment (Conestoga-Rovers & Associates [CRA], 2000). All sample handling and chemical analyses were in accordance with the most recent Puget Sound Estuary Program (PSEP) protocols (PSEP 1986 as updated in 1989, 1991, 1995, and 1997).

This document summarizes the procedures used to characterize the nature and extent of surface sediment contamination at the Navy Bank area. Sediment chemistry and confirmatory bioassay results are presented and compared with SQOs. Based on these data, recommendations for appropriate remedial actions in this area are presented.

2 REPORT ORGANIZATION

This report presents the results of the sampling and analysis program as described in the project SAP (CRA, 2000). This report is organized as follows:

- Section 1 – Introduction
- Section 2 – Report Organization
- Section 3 – Sediment Sampling Effort
- Section 4 – Chemical/Physical Analyses
- Section 5 – Confirmatory Bioassay Testing
- Section 6 – Conclusions/Discussion
- Section 7 – References

Figures and Tables compiling and illustrating the data are presented at the end of this document.

Appendices provide supporting project documentation and are organized as follows:

- Appendix A – Phase 1 Field Activities Report (please note that this appendix also contains the SAP and Quality Assurance Project Plan [QAPP])
- Appendix B – Phase 2 Sampling and Analysis Plan Addendum and Field Report
- Appendix C – Phase 1 Chemistry Data Validation Report
- Appendix D – Phase 2 Chemistry Data Validation Report
- Appendix E – Bioassay Data Validation Report

3 SEDIMENT SAMPLING EFFORT

This section summarizes the sampling strategy (CRA, 2000) for the Navy Bank Surface Sediment Characterization. Sediment field collection reports are provided in Appendices A and D.

3.1 SUMMARY OF SAMPLE COLLECTION

The bank and side-slope area along the Navy and Marine Corps Reserve property was characterized during two successive phases of the investigation. In accordance with the SAP (CRA, 2000), the Navy Bank area was initially divided up into four longitudinal segments, which in turn were further subdivided into intertidal and subtidal sections (Figure 1). During the Phase I sampling on February 16 and 17, 2000, Anchor and CRA collected sediment composite samples from each of the eight (8) sections, and submitted all 8 samples to the analytical laboratory for physical and chemical determinations.

Four (4) of the 8 grid areas sampled during Phase I exceeded SQOs (see below). In order to complete confirmatory chemical and biological testing, Anchor and GeoEngineers, Inc. (GEI) subsequently resampled these 4 areas during the Phase 2 investigation on June 5, 2000 (Figure 2). Analytical Resources, Inc. (ARI), located in Seattle, Washington, conducted all chemical analyses of the sediment samples. EVS Environment Consultants (EVS), located in North Vancouver, British Columbia, conducted the bioassay testing for the Phase 2 sediment samples.

All bank (intertidal) sediment samples were collected from the 0 to 10 centimeter (cm) depth interval by hand at low tide using pre-cleaned stainless steel utensils. Four (4) discrete samples were collected within each intertidal section and composited into one a single sample for chemical determinations, except for samples collected for volatile organic compound (VOC) analyses, which were collected as discrete samples.

All side-slope (subtidal) sediment samples were collected from the 0 to 10 cm depth interval using either a stainless steel petit ponar or stainless steel van Veen sampler. Samples were collected from two (2) discrete locations within each of the subtidal sections and composited into one sample for chemical and/or biological determinations, except for samples collected for VOC analyses, which were collected as discrete samples.

A field log was maintained throughout the Phase 1 and Phase 2 sampling events. The field log included the following information:

- Project number
- Sample matrix
- Name of sampler
- Sample source
- Date and time of sampling
- Weather conditions
- Water depth (if applicable)
- Station location
- Analysis to be conducted
- Sampling method
- Appearance of each sample (i.e., color, consistency, odor, staining, etc)

- Preservation added (if applicable)

All equipment was decontaminated prior to sample collection using the following procedures:

- Non-phosphate detergent wash
- Distilled water rinse
- Isopropanol rinse
- Air dry
- Distilled water rinse

All non-VOC samples collected within a grid section were placed into a pre-cleaned stainless steel bowl for homogenization. Samples were homogenized by mixing the sample using pre-cleaned stainless steel spoons until the sample appeared uniform in color and texture. Sufficient sample for the required analyses were taken from the bowl and placed directly into pre-cleaned, certified sample containers provided by the laboratory. Care was taken to not include large pieces of gravel or debris in the samples. The Phase 1 and 2 sample compositing scheme is provided in Table 1.

The labeled, filled sample containers were individually wrapped and placed on ice in coolers. A chain-of-custody form was completed, placed in a plastic bag, and taped to the inside lid of each cooler. Sample coolers were delivered to the analytical laboratory by courier within 24 hours of sample collection.

The persons transferring custody of the sample container signed the chain-of-custody form upon transfer of sample possession to the analytical laboratory. The shipping container seal was broken upon receipt of samples at the laboratory and the receiver recorded the condition of the samples. Chain-of-custody forms were used internally by the lab to track sample handling and final disposition.

All samples were maintained according to the appropriate holding times and temperatures for each analysis as represented in Table C5.1 of the QAPP (contained in Appendix A).

3.2 FIELD QUALITY ASSURANCE SAMPLES

Field quality assurance samples were collected to assess potential problems as a result of sample processing in the field. One field equipment rinseate blank was submitted to the laboratory for analysis for each phase of sampling. The rinseate blanks were analyzed for metals, semivolatile organic compounds (SVOCs), pesticides, and polychlorinated biphenyls (PCBs). No compounds or analytes were detected in the equipment rinseate blanks collected, except for bis(2-ethylhexyl)phthalate in the rinseate blank associated with the Phase 1 sampling. The rinseate blank collected during the Phase 1 sampling event contained a relatively low level of bis(2-ethylhexyl)phthalate. Samples with similar concentrations were qualified as non-detects during data validation (See Appendix C Table 11).

In addition, one field duplicate was collected during the Phase 1 sampling to assess the aggregate precision of sampling techniques and laboratory analysis. The analytical results showed acceptable analytical and sampling precision with the exception of variability observed between some SVOC and metals results. The sample and its field duplicate (SE-021600-JSV-026) were qualified as estimated for these compounds (see Appendix C Table 12).

3.3 DEVIATIONS FROM THE SAMPLING PLAN

Samples collected during the Phase 2 sampling were homogenized in decontaminated high-density polyethylene containers using a decontaminated stainless steel paddle and a variable speed drill. This deviation did not impact the quality of the data.

4 CHEMICAL/PHYSICAL ANALYSES

A total of 13 sediment samples (9 from Phase 1 and 4 from Phase 2) and two equipment rinseate blank samples were submitted to Analytical Resources, Inc. of Seattle, Washington, for chemical testing. The chemistry data are summarized in Table 2.

4.1 METHODS

All sediment samples were analyzed in accordance with the methods outlined in the SAP.

4.2 DATA QUALITY ASSESSMENT

The overall data quality objectives for collection and chemical testing of sediment samples were met, as set forth in the SAP. All data for this project are considered acceptable for use as qualified. The data validation reports are presented in Appendices C and D of this report for the Phase 1 and 2 samples, respectively.

During the initial Phase 1 sampling, copper and nickel concentrations detected in the intertidal composite sample collected from Segment 1 (i.e., Sample 1I) marginally exceeded (by less than 1.5 times) the SQO chemical criteria for these chemicals (Table 2). However, concentrations of these analytes detected in the Phase 2 composite sample of this same area were well below SQO criteria. Moreover, the average concentrations of the Phase 1 and Phase 2 samples were also below SQO chemical criteria. Based on these data, chemical concentrations within intertidal area of Segment 1 were determined to be below SQO criteria, and were therefore not submitted for confirmatory biological determinations. Concentrations of contaminants detected at the subtidal sampling locations were similar between Phase 1 and 2, as summarized in Table 2.

5 CONFIRMATORY BIOASSAY TESTING

This section summarizes the confirmatory biological testing conducted on three marine surface sediment composite samples (0 to 10 cm): MHB-034, MHB-035, and MHB-036. As detailed in the SAP Addendum (see Appendix B), these composites were submitted for biological testing based on an exceedance (or near exceedance) of SQOs (CRA, 2000). Three toxicity tests were conducted:

- 10-day amphipod mortality test using *Eohaustorius estuarius*;
- 48-hour larval bivalve development test using the mussel *Mytilus galloprovincialis*; and
- 20-day juvenile polychaete growth test using *Neanthes arenaceodentata*.

EVS Environment Consultants, located in North Vancouver, British Columbia, performed all toxicity tests. The bioassay testing results were compared to the SMS biological testing interpretive criteria. This section provides a brief description of the testing methods, a summary of the quality assurance/quality control (QA/QC) review, results from the three toxicity tests, and comparisons of the toxicity test results with SMS interpretive criteria.

5.1 METHODS

Sediment samples from the three (3) Navy Bank area stations that exceeded SQO chemical criteria (Sections 1S, 2S, and 3S; see Figures 1 and 2), along with two Carr Inlet reference stations, were submitted for toxicity testing. The two reference sediment samples were included in each test series, as were the required controls. Sediment samples were received by the laboratory on June 29, 2000 and stored in the dark at 4°C until testing was initiated. The amphipod and juvenile polychaete toxicity tests were initiated July 6, 2000. The larval bivalve toxicity test was initiated on July 18, 2000.

Testing followed protocols recommended by PSEP (1995) and subsequent Sediment Management Annual Review Meeting (SMARM) updates (DMMO 2000). The endpoints measured included survival and sediment avoidance of amphipods, survival and percent abnormality of bivalve larvae, and mortality and growth of polychaetes.

As set forth in the Commencement Bay Nearshore/Tideflats Record of Decision and the SMS, the determination of whether adverse biological effects are observed in a test sediment is established in part by a pairwise statistical comparison of test sediments with appropriate reference sediments. Bioassay endpoint data expressed as percentages were transformed using the arcsine-square root transformation. Prior to hypothesis testing, assumptions of normality and homogeneity of variance of the replicate endpoint data were tested using the Shapiro-Wilk's or Kolmogorov D test and Bartlett's test, respectively. Homoscedastic t-tests or non-parametric heteroscedastic t-tests were used for the hypothesis testing. The statistics were then compared to interpretive criteria for biological effects to yield pass/fail evaluations for each test sample.

Test statistics were interpreted according to the SQO/sediment quality standards (SQS) and cleanup screening levels (CSL) interpretive criteria for biological effects.

5.2 DATA QUALITY ASSESSMENT

All toxicity test results included in this report were deemed acceptable for use in site characterization. The data validation report for the biological testing is presented in Appendix E

and describes the general procedures used to conduct the toxicity tests, discusses specific deviations from environmental test parameters for each type of toxicity test, and presents an evaluation of the effects of these deviations. Please refer to the quality assurance review for additional details on test performance and acceptability.

5.3 TOXICITY TEST RESULTS AND COMPARISON TO SMS INTERPRETATION CRITERIA

The results for the individual replicates of the amphipod (*E. estuarius*), larval bivalve (*M. galloprovincialis*), and juvenile polychaete (*N. arenaceodentata*) bioassay tests are presented in Tables 4, 5, and 6, respectively. Test sediment samples were matched with appropriate reference stations for comparison to SMS interpretation criteria based on the percent of fine-grained sediments (percent fines) in the samples. The percent of fines in test sediments MHB-034 and MHB-036 were 57.6 and 65.5 percent, respectively. These stations were compared to results of reference sediment CR-24 that had 70 percent fines. Test sediment MHB-035 had 31.9 percent fines and was compared to reference sediment CR-23W (36 percent fines).

5.3.1 Amphipod Test

Ammonia-N and total sulfide concentrations were measured in test sediments, reference sediments, and the negative control before and during testing. Interstitial sediment porewater concentrations of ammonia-N were greater than 10 mg/L N in all three test sediments at test initiation, but decreased throughout the testing period (Table 7). Total sulfide concentrations were low or non-detected during all measurement times, except for in the measurement taken in reference sediment CR-23W prior to test set-up. Concentrations in CR-23W at that time were 28 mg/L.

Reference sediment and control tests achieved the SMS performance criteria. A summary of the reference station and control results is presented in Table 8.

All test sediment samples passed both the SQS and CSL criteria for amphipod survival. Table 9 summarizes the amphipod testing results and compares them to SMS criteria. Mean amphipod survival ranged between 83 and 94 percent, a difference of 5 to 15 percent lower than the matched reference sediments. Differences between test and reference samples were statistically significant ($p < 0.05$) for all three stations. These results are well within compliance for SQS biological effects criteria.

5.3.2 Larval Bivalve

Ammonia-N concentrations were measured in test sediments, reference sediments, and the negative control at test initiation, and total sulfide concentrations were measured at test initiation and completion. Ammonia-N and total sulfide concentrations did not exceed 0.36 mg/L and 0.03 mg/L, respectively, in any samples (Table 10).

A summary of the reference station and control results is presented in Table 11. Reference sediment CR-24 and control tests achieved the SMS performance criteria. Reference sediment CR-23W did not achieve the SMS performance criteria. The net percent normal survival in reference sediment CR-23W (i.e., mean percent normal survival in test sediment divided by the mean percent normal survival in negative control) was 61.4 percent and thus did not meet the SMS 65 percent performance criterion. In the case of the reference area performance "failures", two approaches may be considered under the SMS to complete the bioassay interpretations. One

approach would be to substitute the "failed" reference test results with the other reference sample match (e.g., substituting the rejected CR-23W larval bivalve test with accepted results from CR-23). Another approach would be to substitute the "failed" reference test results with the negative control test data. Since this latter approach would result in the most conservative SMS interpretation (i.e., more likely to detect an exceedance of SQS biological criteria), the negative control comparison was used for the purpose of initial bioassay interpretations.

Table 12 summarizes the larval bivalve testing results and compares them to SMS criteria. Test sediments MHB-035 and MHB-036 exceeded SQS criteria but passed CSL criteria. Mean normal survival for the 48-hour larval bivalve test standardized to the negative control in samples MHB-035 and MHB-036 were 78.8 and 65.2 percent, respectively. Normal survivorship in both stations was significantly different ($p < 0.10$) than the appropriate reference/control sample. Test sediment MHB-034 passed SQS and CSL biological effects interpretive criteria.

5.3.3 Juvenile Polychaete

Ammonia-N and total sulfide concentrations were measured in test sediments, reference sediments, and the negative control during testing. Interstitial sediment porewater concentrations of ammonia-N were greater than 10 mg/L N in all three test sediments at test initiation, but decreased throughout the testing period (Table 13). Total sulfide concentrations were low or non-detected during all measurement times.

Reference sediment and control tests achieved the SMS performance criteria. A summary of the reference station and control results is presented in Table 14.

All test sediments passed both the SQS and CSL criteria for juvenile polychaete growth (Table 15). The mean individual growth rate in the juvenile polychaete test ranged from 0.61 to 0.75 mg/individual/day and survival was 96 percent or greater in all three test sediments. Differences in mean individual growth rate between test and reference samples were not statistically significant ($p > 0.05$) at stations MHB-034 and MHB-035, but were significantly different at station MHB-036. Again, all results are well within compliance with SQS biological effects criteria.

5.4 Overall Conclusion

Based on the results of the three toxicity tests, test sediments collected from Navy Bank segments 2S and 3S (Samples MHB-035 and MHB-036) exceeded SQS biological effects interpretive criteria. For both stations, this is due to an exceedance in the larval bivalve tests. Navy Bank Segment 1S (Station MHB-034) passed SQS and CSL criteria for all three toxicity tests. A summary of the interpretation of the bioassay tests is provided in Table 16.

6 DISCUSSION

6.1 COMPARISON WITH SEDIMENT QUALITY OBJECTIVES

As set forth in the SAP and in the U.S. Environmental Protection Agency's Commencement Bay Record of Decision and Explanation of Significant Differences, appropriate benchmarks of sediment quality used for this sediment characterization were based on SQOs. A summary of the chemical and biological determinations along with the SQO criteria comparisons is provided in Tables 2 and 3. Chemical analytes/compounds that exceed the SQO chemical or confirmatory biological criteria were as follows:

Segment 1:

- **Intertidal** (1I): During the initial Phase 1 sampling, copper and nickel concentrations detected in the intertidal composite sample collected from Segment 1 marginally exceeded (by less than 1.5 times) the SQO chemical criteria for these chemicals (Table 2). However, concentrations of these analytes detected in the Phase 2 composite sample of this same area were well below SQO criteria. Moreover, the average concentrations of the Phase 1 and Phase 2 samples were also below SQO chemical criteria. Based on these data, chemical concentrations within intertidal area of Segment 1 were determined to be below SQO criteria, and were therefore not submitted for confirmatory biological determinations.

- **Subtidal** (1S): Concentrations of acenaphthene, fluorene, hexachlorobutadiene, and/or DDD exceeded SQO chemical criteria in either the Phase 1 or Phase 2 samples (Table 2). The Phase 2 sediment sample was submitted for confirmatory bioassay testing and passed all bioassay interpretive criteria (Table 16), indicating that sediments in this area are below SQO criteria.

Segment 2:

- **Intertidal** (2I): Phase 1 chemical concentrations in this area were all below SQO chemical criteria (Table 2).

- **Subtidal** (2S): Concentrations of phenanthrene, fluoranthene, total high molecular weight polycyclic aromatic hydrocarbons (HPAHs), and/or DDD exceeded SQO chemical criteria in either the Phase 1 or Phase 2 samples (Table 2). The Phase 2 sediment sample was submitted for confirmatory bioassay testing and failed the SQS/SQO bioassay interpretive criteria, but did not exceed MCUL interpretive criteria (Table 16). As set forth in the U.S. Environmental Protection Agency's Commencement Bay Record of Decision and Explanation of Significant Differences, and in the Hylebos Waterway Pre-Remedial Design Evaluation Report (PRDE; HCC 1999), sediments in this area may be considered for natural recovery.

Segment 3:

- **Intertidal** (3I): Phase 1 chemical concentrations in this area were all below SQO chemical criteria (Table 2).

- **Subtidal** (3S): Concentrations of HPAHs, fluoranthene, pyrene, benz(a)anthracene, benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene exceeded SQO chemical criteria in either the Phase 1 or Phase 2 samples (Table 2). The Phase 2 sediment sample was submitted for confirmatory bioassay testing and failed the SQS/SQO bioassay interpretive criteria, but did not exceed MCUL interpretive criteria (Table 16). As set forth in the U.S. Environmental Protection Agency's Commencement Bay Record of Decision and Explanation of Significant Differences, and in the Hylebos Waterway PRDE Report (HCC 1999), sediments in this area may be considered for natural recovery.

Segment 4:

- **Intertidal** (4I): Phase 1 chemical concentrations in this area were all below SQO chemical criteria (Table 2).

- **Subtidal** (4S): Phase 1 chemical concentrations in this area were all below SQO chemical criteria (Table 2).

6.2 RECOMMENDED REMEDIATION PLAN

Based on the sediment sampling data described herein, all intertidal sediments within the Navy Bank area currently comply with SQO criteria, and thus do not require remedial action. In addition, two of the subtidal sediment sections located at either end of this area (Segments 1S and 4S; see Figure 1), were also determined to comply with SQO criteria, and do not require remedial action.

The two (2) subtidal sediment grids located within the center of the Navy Bank area, and immediately below the existing pier (Segments 2S and 3S; see Figure 1), exhibited minor biological effects during this study (above SQO/SQS criteria), but did not exceed severe effects (MCUL) criteria. In addition, the maximum concentrations of chemical contaminants (primarily HPAHs) detected within this area were less than 2 times greater than the corresponding SQO chemical criteria. As presented in the PRDE Report (HCC, 1999), since net sedimentation occurs within this area of the waterway (exceeding roughly 1 centimeter per year), and since incoming (source) concentrations of PAHs and DDD to the waterway are relatively low (well below SQO chemical criteria), chemical concentrations below the Navy Bank pier have been predicted to decline to well below the SQO criteria within the 10-year recovery period. Further, these natural recovery estimates are conservative, in that they do not account for new sources of clean sediment to this area that will result from the cleanup (dredging) of the adjacent waterway area.

Since dredging or capping of the Navy Bank under-pier area would be technically difficult, and would likely lead to impacts to the pier structure, and since natural recovery is expected to reduce chemical concentrations to below SQO criteria with a 10-year period following dredging of the adjacent waterway, monitored natural recovery is the recommended action within this area. Natural recovery in this case is consistent with the U.S. Environmental Protection Agency's Commencement Bay Record of Decision and Explanation of Significant Differences. Natural recovery monitoring of Navy Bank Segments 2S and 3S would occur during years 2, 5, and 10 following completion of remedial construction (i.e., dredging of the adjacent waterway). The natural recovery monitoring in this area would include analysis for all chemicals presently above SQO chemical criteria, including PAHs and DDD.

7 REFERENCES

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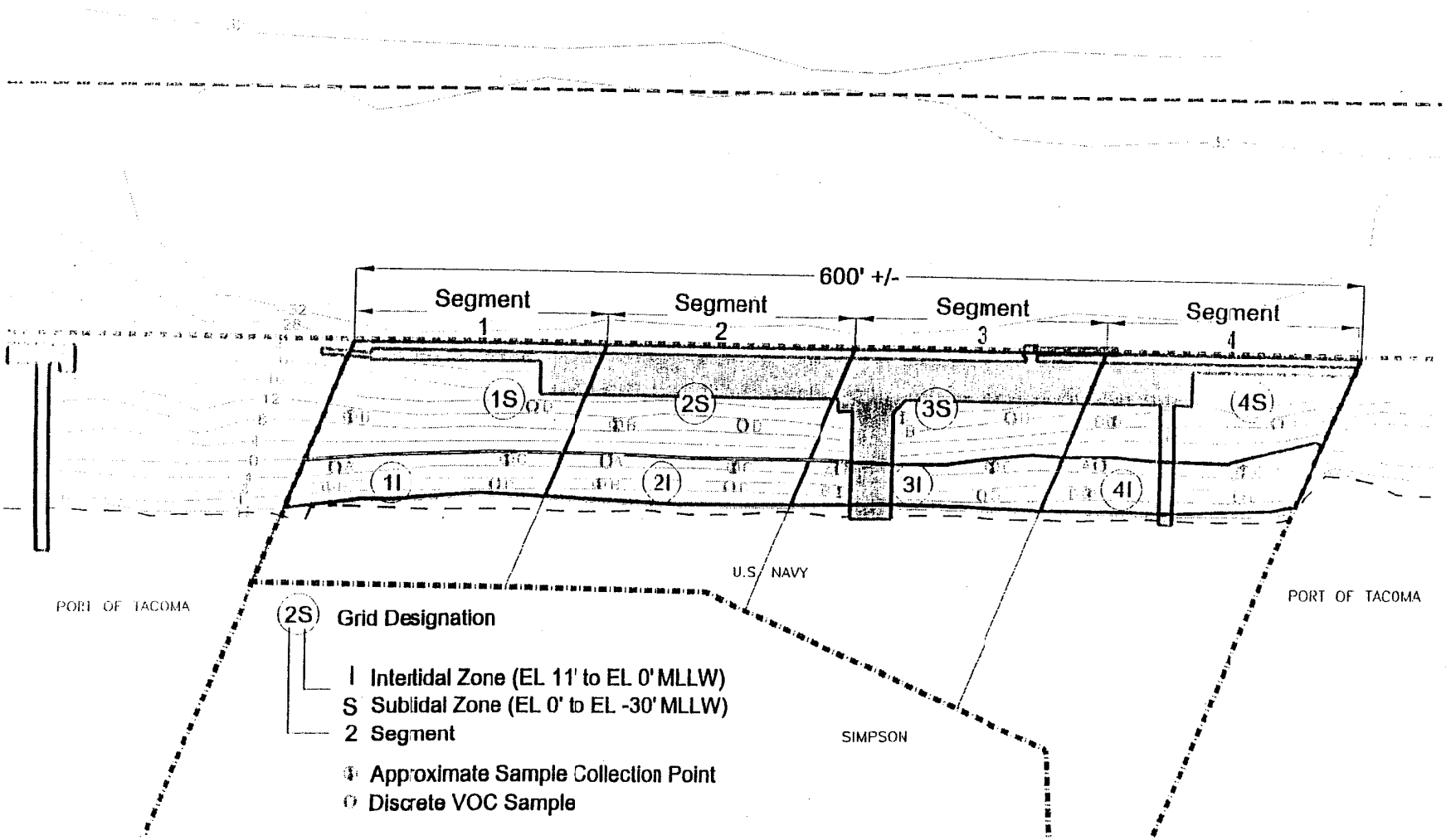
FIGURES AND TABLES



SOURCES:

ANCHOR ENVIRONMENTAL, L.L.C.

GeoEngineers

CRA

NOTE:

THE ACTUAL LOCATIONS AND ELEVATIONS OF SAMPLE COLLECTION POINTS WILL BE PRESENTED IN THE CHARACTERIZATION REPORT.

0 30 90ft

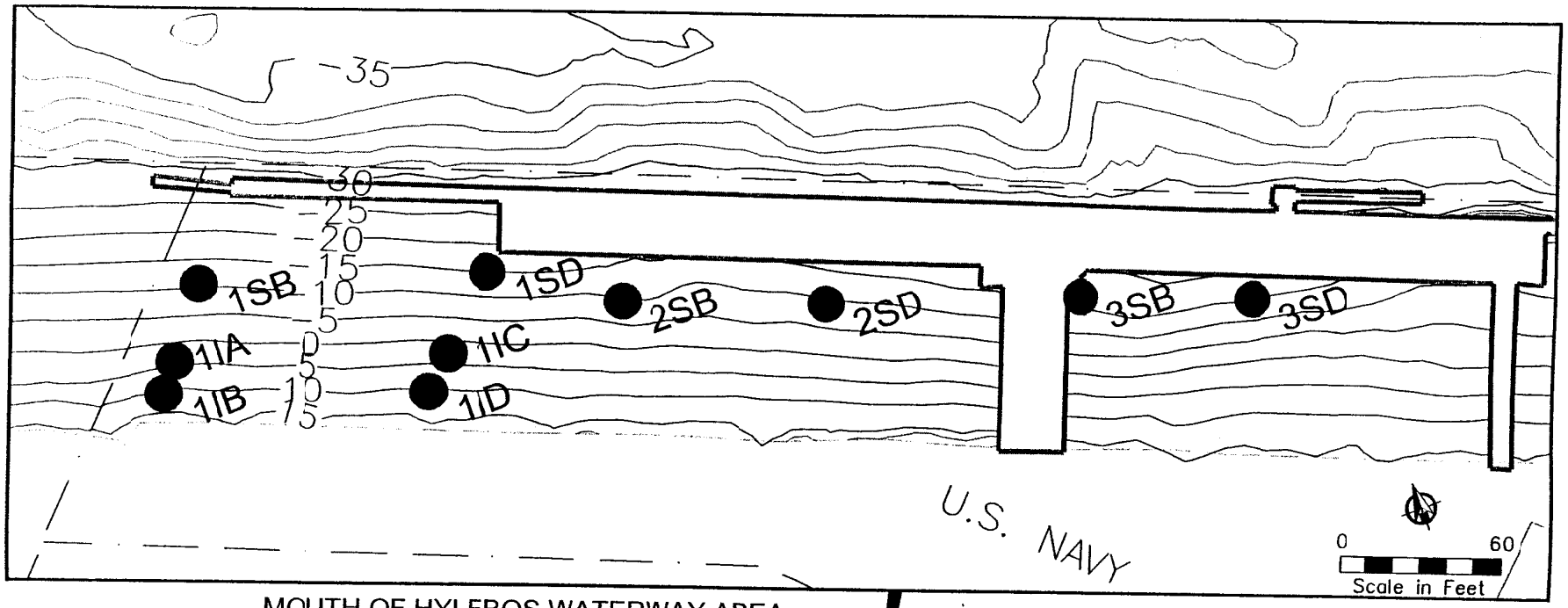
figure 1

PHASE I SAMPLING GRIDS

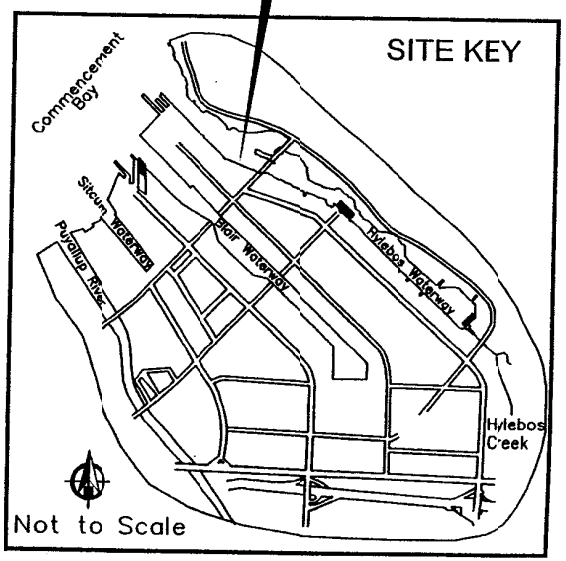
NAVY BANK SEDIMENT CHARACTERIZATION

Port of Tacoma/Occidental Chemical Corporation

15403--10(002)GN-NF003 FEB 24/2000



MOUTH OF HYLEBOS WATERWAY AREA



Notes:

1) All elevations shown are referenced to Mean Lower Low Water = 0.0' (Port of Tacoma) based on the Tacoma Public Works Dept. datum chart dated January 1, 1992 and based upon NOAA Publication dated 9/19/85, for Tacoma, Commencement Bay.
2) Bathymetric contours for Hylebos Waterway derived from hydrographic surveys performed by Blue Water Engineering in June 1993, March 1994 and June 1998.

ANCHOR ENVIRONMENTAL, L.L.C.

06/27/01 GSN002-02.DWG 0004909

Figure 2
Navy Bank Sediment Characterization
Phase 2 Sample Locations

Table 1. Sample compositing scheme

Segment No.	Intertidal/Subtidal	Station No.	Composite Sample ID
Phase 1 Sampling (February 2000)			
1	Intertidal	1IA, 1IB, 1IC, 1ID	JSV-018
1	Subtidal	1SB, 1SD	JSV-029
2	Intertidal	2IA, 2IB, 2IC, 2ID	JSV-019
2	Subtidal	2SB, 2SD	JSV-030
3	Intertidal	3IA, 3IB, 3IC, 3ID	JSV-020 and JSV-026
3	Subtidal	3SB, 3SD	JSV-031
4	Intertidal	4IA, 4IB, 4IC, 4ID	JSV-021
4	Subtidal	4SB, 4SD	JSV-032
Phase 2 Sampling (June 2000)			
1	Intertidal	1IA, 1IB, 1IC, 1ID	MHB-033
1	Subtidal	1SB, 1SD	MHB-034
2	Subtidal	2SB, 2SD	MHB-035
3	Subtidal	3SB, 3SD	MHB-036

	Sediment Management Standards		Segment 1 - Intertidal			Segment 1 - Subtidal		
Chemical	SQS	CSL	Average	Feb-00	Jun-00	Average	Feb-00	Jun-
Di-n-octyl phthalate	58	4,500	1.1 U	1.6 U	0.67 U	0.98 U	1.1 U	0.6
Phenols and Miscellaneous Extractables (ug/kg)								
Phenol	420	1,200	84	37 U	130	70	19 U	12
2-Methylphenol	63	63	29 U	37 U	20 U	20 U	19 U	2
4-Methylphenol	670	670	29 U	37 U	20 U	20 U	19 U	2
2,4-Dimethylphenol	29	29	29 U	37 U	20 U	20 U	19 U	2
Pentachlorophenol	360	690	144 U	190 U	98 U	98 U	97 U	9
Benzyl alcohol	57	73	29 U	37 U	20 U	20 U	19 U	2
Benzoic acid	650	650	285 U	370 U	200 U	195 U	190 U	20
Miscellaneous Extractables (mg/kg-oc)								
Dibenzofuran	15	58	2.8	2.8	2.8	15	**29**	1
Hexachloroethane	---	---	1.1 U	1.6 U	0.67 U	1.3	1.5	1
Hexachlorobutadiene	3.9	6	0.07	0.078	0.057	0.46	0.33	0.5
N-Nitrosodiphenylamine	11	11	1.1 U	1.6 U	0.67 U	0.98 U	1.1 U	0.6
PCBs (mg/kg-oc)	---							
Aroclor 1016	---	---	0.43 U	0.74 U	0.13 U	0.98 U	1.1 U	0.6
Aroclor 1242	---	---	3.9 Y	4.8 U	3.1 Y	6.0 Y	7.1 U	5
Aroclor 1248	---	---	2.7 U	5.2 U	0.13 U	10 Y	7.1 U	
Aroclor 1254	---	---	4.5 Y	6.5 U	2.5 Y	16 Y	19 U	
Aroclor 1260	---	---	2.5 Y	3.9 U	1.2 Y	8.5 Y	8.2 U	8
Aroclor 1221	---	---	0.89 U	1.5 U	0.25 U	10 Y	2.3 U	
Aroclor 1232	---	---	0.43 U	0.74 U	0.13 U	4.1 Y	1.1 U	7
Total PCBs (ug/kg)	12	65	4.8 Y	6.5 U	3.1 Y	18 Y	19 U	
SMS Bioassay Interpretation			na	na	na	na	na	Pa
Overall Cleanup Interpretation				PASS			PASS	

Notes:

J - Indicates an estimated concentration when the value is less than the calculated reporting limit.

M - Value is a mean.

N - Estimate based on presumptive evidence.

R - Result is rejected. See validation report for reasons for rejection.

U - Undetected at the detection limit shown.

Y - Indicates raised reporting limit due to interference.

na - Not analyzed.

nc - Not calculated.

(1) 2-Methylnaphthalene is not included in the Total LPAH calculation.

(2) Total LPAHs and HPAHs are the sum of all detected contaminants within the subheading. When all isomers were not detected, the highest detection limit was Qualifiers were attached to the Total LPAHs or HPAHs value if any of the contributing concentrations were denoted with that qualifier.

(3) Total benzofluoranthene criterion represents the sum of the detected concentrations of the b and k isomers (the j isomer co-elutes with k). When all isomers w the highest detection limit was reported as the sum. Qualifiers were attached to the total benzofluoranthenes value if any of the contributing concentrations we denoted with that qualifier.

Bold - Bold text denotes exceedance of Sediment Management Standards SQS sediment quality criteria.

Shaded - Shaded cells denote exceedance of Sediment Management Standards CSL sediment quality criteria.

Segment 2 - Intertidal	Segment 2 - Subtidal			Segment 3 - Intertidal	Segment 3 - Subtidal			Segment 4 - Intertidal	Segment 4 - Subtidal
Feb-00	Average	Feb-00	Jun-00	Feb-00	Average	Feb-00	Jun-00	Feb-00	Feb-00
0.87 U	0.81 U	0.76 U	0.86 U	1.3 U	1.0 U	1.5 U	0.59 U	1.6 U	1.2 U
20 U	105	19 U	190	19 U	65	19 U	110	19 U	38 M
20 U	19 U	19 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U
20 U	19 U	19 U	19 U	19 U	21	19 U	22	19 U	19 U
20 U	19 U	19 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U
100 U	96 U	95 U	96 U	96 U	98 U	97 U	99 U	95 U	96 U
20 U	19 U	19 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U
200 U	190 U	190 U	190 U	190 U	195 U	190 U	200 U	190 U	190 U
0.87 U	4.0	3.6	4.4	1.6	4.3	5.9	2.6	1.6	1.6
0.87 U	0.81 U	0.76 U	0.86 U	1.3 U	1.0 U	1.5 U	0.59 U	1.6 U	1.2 U
0.17	0.18	0.13	0.24	0.059 U	0.16	0.085	0.24	0.073 U	0.069
0.87 U	0.81 U	0.76 U	0.86 U	1.3 U	1.0 U	1.5 U	0.59 U	1.6 U	1.2 U
0.83 U	0.79 U	0.76 U	0.82 U	1.2 U	0.79 U	1.5 U	0.11 U	1.5 U	1.2 U
4.0 U	4.1 Y	5.6 U	2.6 Y	1.9 U	2.2 Y	2.3 U	2.0 Y	1.6 U	2.2 U
7.0 U	5.2 Y	4.4 U	5.9 Y	4.1 U	3.9 Y	3.3 U	4.4 Y	2.3 U	1.3 U
12 U	7.8 Y	10 U	5.9 Y	1.2 U	4.1 Y	5.8 U	2.4 Y	1.8 U	5.2 U
4.3 U	4.2 Y	3.8 U	4.5 Y	2.7 U	2.7 Y	4.5 U	0.79 Y	1.8 U	2.8 U
1.6 U	7.6 Y	1.5 U	14 Y	2.4 U	1.6 U	3.0 U	0.23 U	2.9 U	2.4 U
0.83 U	1.6 Y	0.76 U	2.4 Y	1.2 U	0.79 U	1.5 U	0.11 U	1.5 U	1.2 U
12 U	12 Y	10 U	14 Y	4.1 U	5.1 Y	5.8 U	4.4 Y	2.9 U	5.2 U
na	na	na	SQS hit	na	na	na	SQS hit	na	na
PASS	SQS			PASS	SQS			PASS	PASS

ted as the sum.

ot detected,

Table 3. Navy Bank data summary and SMS comparison

	Sediment Management Standards		Segment 1 - Intertidal			Segment 1 - Subtidal		
Chemical	SQS	CSL	Average	Feb-00	Jun-00	Average	Feb-00	Ju
Conventional Parameters								
Total solids (%)	---	---	75	81	70	56	65	
Gravel (%)	---	---	48	NA	48	NA	NA	
Sand (%)	---	---	47	NA	47	NA	NA	
Silt (%)	---	---	2.2	NA	2.2	NA	NA	
Clay (%)	---	---	3.0	NA	3.0	NA	NA	
Total organic carbon (%)	---	---	2.7	2.3	3.0	2.1	1.7	
Metals (mg/kg)								
Antimony	---		nc	R	7.0 U	nc	R	
Arsenic	57	93	8.5	10	7.0 U	12	9.0	
Cadmium	5.1	6.7	0.35	0.40	0.30 U	0.35	0.30	
Chromium	260	270	**2,175**	**2,260 J**	**2,090**	**350**	**555 J**	
Copper	390	390	292	**549**	35	107	66	
Lead	450	530	65	77	52	113	99	
Mercury	0.41	0.59	0.12	0.15	0.080	0.16	0.11	
Nickel	---	---	120 J	203 J	36	26	25 J	
Silver	6.1	6.1	0.40 U	0.40 U	0.40 U	0.45	0.30 J	
Zinc	410	960	100	127	72	119	87	
Organics (mg/kg-oc)								
Total LPAH[1][2]	370	780	58	65	51	136	216	
Naphthalene	99	170	3.3	3.6	3.1	18	35	
Acenaphthylene	66	66	2.2	3.4	1.0	4.0	3.4	
Acenaphthene	16	57	4.8	5.2	4.3	**27**	**52**	
Fluorene	23	79	4.7	4.8	4.7	19	**36**	
Phenanthrene	100	480	32	36	28	50	71	
Anthracene	220	1,200	11	12	10	18	19	
2-Methylnaphthalene	38	64	1.3	1.6 U	1.1	2.5	4.0	
Total HPAH[2]	960	5,300	275	334 J	215	325	308	
Fluoranthene	160	1,200	60	83	37	57	48	
Pyrene	1,000	1,400	43	42	43	43	46	
Benz(a)anthracene	110	270	17	17	18	30	27	
Chrysene	110	460	28	31	25	55	44	
Benzo(b)fluoranthene	---	---	44	57	31	46	46	
Benzo(k)fluoranthene	---	---	27	34	19	33	35	
Benzofluoranthenes (b+k)[3]	230	450	70	91	50	79	82	
Benzo(a)pyrene	99	210	26	30	21	35	32	
Indeno(1,2,3-c,d)pyrene	34	88	14	18	10	13	14	
Dibenz(a,h)anthracene	12	33.0	3.2	4.1	2.3	3.1	3.2	
Benzo(g,h,i)perylene	31	78.0	14	19 J	9.0	10	12	
Chlorinated Hydrocarbons (mg/kg-oc)								
1,2,4-Trichlorobenzene	0.81	1.8	na	1.6 U	na	na	1.1 U	
1,2-Dichlorobenzene	2.3	2.3	na	1.6 U	na	na	1.1 U	
1,3-Dichlorobenzene	---	---	na	1.6 U	na	na	1.1 U	
1,4-Dichlorobenzene	3.1	9.0	na	1.6 U	na	na	1.1 U	
Hexachlorobenzene (HCB)	0.38	2	0.79 Y	1.1 U	0.50 Y	0.90 Y	1.1 U	
Phthalates (mg/kg-oc)								
Dimethyl phthalate	53	53	1.1 U	1.6 U	0.67 U	0.98 U	1.1 U	
Diethyl phthalate	61	110	1.1 U	1.6 U	0.67 U	0.98 U	1.1 U	
Di-n-butyl phthalate	220	1,700	1.1 U	1.6 U	0.67 U	0.98 U	1.1 U	
Butyl benzyl phthalate	4.9	64	1.1 U	1.6 U	0.67 U	0.98 U	1.1 U	
Bis(2-ethylhexyl) phthalate	47	78	8.7	11	6.0	13	14	

	Segment 2 - Intertidal	Segment 2 - Subtidal			Segment 3 - Intertidal	Segment 3 - Subtidal			Segment 4 - Intertidal	Segment 4 - Subtidal
	Feb-00	Average	Feb-00	Jun-00	Feb-00	Average	Feb-00	Jun-00	Feb-00	Feb-00
	73	56	55	56	78	56	72	39	75	66
	NA	13	NA	13	NA	22	NA	22	NA	NA
	NA	55	NA	55	NA	12	NA	12	NA	NA
	NA	17	NA	17	NA	33	NA	33	NA	NA
	NA	15	NA	15	NA	33	NA	33	NA	NA
	2.3	2.4	2.5	2.2	1.5	2.4	1.3	3.4	1.2	1.6
	R	nc	R	4.0 U	R	nc	R	6.0 U	R	R
	20	12	13	11	6.0	12	6.0	18	7.0	10
	0.30 U	0.35	0.30	0.40	0.20 U	0.40	0.30	0.50	0.30 U	0.30
	2,250 J	122	154 J	89	**2,350 J**	973	**1,880 J**	65	**2,610 J**	82 J
	69	71	73	69	33	73	34	111	26	45
	81	77	84	70	33	66	41	90	28	38
	0.090	0.14	0.13	0.15	0.040	0.16	0.090	0.23	0.040	0.080
	64 J	22	21 J	22	35 J	33	37 J	28	40 J	18 J
	0.40 U	0.35	0.30 J	0.40	0.40 U	0.35	0.20 U	0.50	0.40 U	0.20 U
	149	157	128	186	106 J	142	66	218	63	83
	17	95	104	86	55	116	168	64	55	98
	0.87 U	3.6	4.0	3.2 U	1.2 J	2.0	2.3	1.7	4.2	1.2 U
	2.0	5.1	5.2	5.0	3.5	9.1	12	5.9	3.7	4.5
	0.87 U	5.3	5.6	5.0	2.7	5.6	8.5	2.8	2.0	1.8
	0.96	6.4	6.4	6.4	3.1	8.5	12	4.7	2.8	4.7
	9.1	59	68	50	33	63	**100**	27	35	75
	5.2	17	14	20	11	27	32	22	6.9	12
	0.87 U	1.6	1.1	2.0	1.3 U	1.7	1.8	1.5	7.1	1.2 U
	156	563	510	617	411	**1113**	**1,609**	617	357	548
	27	135	124	145	63 J	**239**	**354**	124	78	144
	21	99	108	91	73	180	292	68	77	113
	10	40	34	45	27	94	**138**	50	19	38
	21	79	68	91	53 J	**145**	**208**	82	45	69
	21	68	64	73	53 J	146	208	85	45	75
	19	58	52	64	45	123	185	62	33	48
	40	126	116	136	99	**270**	**392**	147	78	123
	13	42	34	50	33	92	**123**	62	23	35
	11	20	13	26	29	**43**	**48**	**38**	18	13
	2.1	6.7	2.9	10	5.9	**14**	**15**	**14**	3.6	3.4 J
	11 J	16	11	21	28 J	**35**	**38**	**32**	18 J	11
	0.87 U	na	0.76 U	na	1.3 U	na	1.5 U	na	1.6 U	1.2 U
	0.87 U	na	0.76 U	na	1.3 U	na	1.5 U	na	1.6 U	1.2 U
	0.87 U	na	0.76 U	na	1.3 U	na	1.5 U	na	1.6 U	1.2 U
	0.87 U	na	0.76 U	na	1.3 U	na	1.5 U	na	1.6 U	1.2 U
	0.65	**0.45**	0.44 U	**0.45**	0.31 U	0.31	0.32 U	0.29	0.19	0.060 U
	0.87 U	0.81 U	0.76 U	0.86 U	1.3 U	1.0 U	1.5 U	0.59 U	1.6 U	1.2 U
	0.87 U	0.81 U	0.76 U	0.86 U	1.3 U	1.0 U	1.5 U	0.59 U	1.6 U	1.2 U
	1.3	0.81 U	0.76 U	0.86 U	1.3 U	1.0 U	1.5 U	0.59 U	1.6 U	1.2 U
	2.5	1.0	0.72 J	1.3	2.5	2.5	1.8	3.2	2.3	1.2 U
	17	16	10	22	8.7 U	36	34	38	8.1 U	11 U

Table 2. Navy Bank data summary and SQO comparison

Chemical	Commencement Bay SQO	Segment 1 - Intertidal			Segment 1 - Subtidal			Seg In
		17 Average	Feb-00	Jun-00	15 Average	Feb-00	Jun-00	
Conventional Parameters								
Phenol	420	84	37 U	130	70	19 U	120	
2-Methylphenol	63	20 U	37 U	20 U	20 U	19 U	20 U	
4-Methylphenol	670	20 U	37 U	20 U	20 U	19 U	20 U	
2,4-Dimethylphenol	29	20 U	37 U	20 U	20 U	19 U	20 U	
Pentachlorophenol	360	98 U	190 U	98 U	98 U	97 U	99 U	
Miscellaneous Extractables (ug/kg)								
Benzyl alcohol	73	20 U	37 U	20 U	20 U	19 U	20 U	
Benzoic acid	650	200 U	370 U	200 U	195 U	190 U	200 U	
Dibenzofuran	540	75	64	85	267	500	34	
Hexachloroethane	---	20 U	37 U	20 U	26	26	25	
Hexachlorobutadiene	11	2	2	2	10	6	**14**	
N-Nitrosodiphenylamine	28	20 U	37 U	20 U	20 U	19 U	20 U	
Pesticides (ug/kg)								
DDE	9.0	2.1 Y	1.7 U	2.5 Y	2.0 U	7.1 U	2.0 U	
DDD	16.0	1.0 J	10.0 U	1.0 J	**24.6**	4.2 M	**45.0**	
DDT	34.0	7.6 J	9.4 J	5.8 Y	5.3 J	8.6 J	2.0 U	
Aldrin	---	1.3 Y	0.9 U	1.7 Y	2.8 Y	1.0 U	4.6 Y	
alpha-Chlordane	---	2.7 Y	3.0 U	2.3 Y	2.4 Y	2.1 U	2.7 Y	
gamma-Chlordane	---	3.4 Y	14.0 U	3.4 Y	4.0 Y	31.0 U	4.0 Y	
Dieldrin	---	8.5 Y	5.0 U	12.0 Y	9.2	8.3	10.0 Y	
Heptachlor	---	1.7 Y	1.7 U	1.7 Y	1.7 Y	2.0 U	1.4 Y	
gamma-BHC (Lindane)	---	9.7	3.3 U	16.0	23.4	2.8 U	44.0	
PCBs (ug/kg)								
Aroclor 1016	---	4 U	17 U	3.8 U	20 U	19 U	20 U	
Aroclor 1242	---	93 Y	110 U	93 Y	120 Y	120 U	120 Y	
Aroclor 1248	---	4 U	120 U	3.8 U	210 Y	120 U	300 Y	
Aroclor 1254	---	75 Y	150 U	75 Y	320 Y	320 U	320 Y	
Aroclor 1260	---	36 Y	89 U	36 Y	175 Y	140 U	210 Y	
Aroclor 1221	---	8 U	35 U	7.5 U	235 Y	39 U	430 Y	
Aroclor 1232	---	4 U	17 U	3.8 U	95 Y	19 U	170 Y	
Total PCBs (ug/kg)	300	93 Y	150 U	93 Y	375 Y	320 U	430 Y	
CB/NT ROD Bioassay Interpretation		na	na	na	na	na	Pass	
Overall Cleanup Interpretation		PASS			PASS			

Master:

J - Indicates an estimated concentration when the value is less than the calculated reporting limit.
M - Value is a mean.
N - Estimate based on presumptive evidence.
R - Result is rejected. See validation report for reasons for rejection.
U - Undetected at the detection limit shown.
Y - Indicates raised reporting limit due to interference.
na - Not analyzed.
nc - Not calculated.
(1) 2-Methylnaphthalene is not included in the total LPAH calculation.
(2) Total LPAHs and HPAHs are the sum of all detected contaminants within the subheading. When all isomers were not detected, the highest detectio
Qualifiers were attached to the Total LPAHs or HPAHs value if any of the contributing concentrations were denoted with that qualifier.
(3) Total benzofluoranthene criterion represents the sum of the detected concentrations of the b and k isomers (the j isomer co-elutes with k). When all
the highest detection limit was reported as the sum. Qualifiers were attached to the total benzofluoranthenes value if any of the contributing concen
denoted with that qualifier.
XX - Shaded cells denote exceedance of Hylebos Cleanup Committee Sediment Quality Objectives (SQO) criteria.

2 - al		Segment 2 - Subtidal		Segment 3 - Intertidal	Segment 3 - Subtidal			Segment 4 - Intertidal	Segment 4 - Subtidal
)	Average	Feb-00	Jun-00	Feb-00	Average	Feb-00	Jun-00	Feb-00	Feb-00
U	105	19 U	190	19 U	65	19 U	110	19 U	38 M
U	19 U	19 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U
U	19 U	19 U	19 U	19 U	21	19 U	22	19 U	19 U
U	19 U	19 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U
U	96 U	95 U	96 U	96 U	98 U	97 U	99 U	95 U	96 U
U	19 U	19 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U
U	190 U	190 U	190 U	190 U	195 U	190 U	200 U	190 U	190 U
U	94	90	97	24	84	77	90	19	25
U	19 U	19 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U
	4	3	5	1 U	5	1	8	1 U	1
U	19 U	19 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U
U	1.9 Y	1.9 U	1.9 Y	1.8 U	2.0	1.9 U	2.0 Y	1.8 U	1.9 U
NJ	11.5	3.0 M	**20.0**	3.9 U	11.8	4.6 NJ	19.0 Y	1.8 U	3.4 U
R	1.8 U	R	1.8 U	6.8 J	3.7 J	4.5 J	2.8 Y	3.9 J	1.9 UJ
U	1.6 Y	1.0 U	2.3 Y	0.9 U	1.8 Y	1.0 U	2.6 Y	0.9 U	1.0 U
U	1.4 Y	1.5 U	1.2 Y	0.9 U	1.3	1.0 U	1.7	0.9 U	1.0 U
U	2.0 Y	38.0 U	2.0 Y	1.7 U	13.3 Y	24.0 U	2.5 Y	1.3 U	16.0 U
U	4.3	4.0	4.5 Y	1.8 U	2.6 Y	1.9 U	3.3 Y	1.8 U	1.9 U
U	1.0 Y	1.0 U	1.0 Y	0.9 U	1.0 U	1.0 U	1.0 U	0.9 U	1.0 U
UJ	7.3 Y	1.5 U	13.0 Y	0.9 U	46.5 Y	1.0 U	92.0 Y	0.9 U	1.0 U
U	19 U	19 U	18 U	18 U	11 U	19 U	3.9 U	18 U	19 U
U	99 Y	140 U	57 Y	29 U	50 Y	30 U	69 Y	19 U	35 U
U	120 Y	110 U	130 Y	61 U	97 Y	43 U	150 Y	27 U	21 U
U	185 Y	240 U	130 Y	18 U	79 Y	76 U	81 Y	22 U	83 U
U	98 Y	95 U	100 Y	40 U	43 Y	59 U	27 Y	21 U	44 U
U	169 Y	38 U	300 Y	36 U	23 U	39 U	7.8 U	35 U	38 U
U	36 Y	19 U	52 Y	18 U	11 U	19 U	3.9 U	18 U	19 U
U	270 Y	240 U	300 Y	61 U	113 Y	76 U	150 Y	35 U	83 U
	na	na	**SQS hit**	na	na	na	**SQS hit**	na	na
	SQS			PASS	**SQS**			PASS	PASS

was reported as the sum.

s were not detected,
were

Table 2. Navy Bank data summary and SQO comparison

Chemical	Commencement Bay SQO	Segment 1 - Intertidal			Segment 1 - Subtidal			Seg In
		11 Average	Feb-00	Jun-00	15 Average	Feb-00	Jun-00	
Conventional Parameters								
Total solids (%)	---	75	81	70	56	65	48	
Gravel (%)	---	48	NA	48	8	NA	8	
Sand (%)	---	47	NA	47	35	NA	35	
Silt (%)	---	2	NA	2	32	NA	32	
Clay (%)	---	3	NA	3	26	NA	26	
Total organic carbon (%)	---	2.7	2.3	3.0	2.1	1.7	2.4	
Metals (mg/kg)								
Antimony	150	nc	R	7 U	nc	R	5 U	
Arsenic	57	9	10	7.0 U	12	9	14	
Cadmium	5.0	0.4	0.4	0.3 U	0.4	0.3	0.4	
Chromium	---	2,175	2,260 J	2,090	350	555 J	144	
Copper	390	292	**549**	35	107	66	149	
Lead	450	65	77	52	113	99	126	
Mercury	1.00	0.12	0.15	0.08	0.16	0.11	0.21	
Nickel	140	120 J	**203 J**	36	26	25 J	27	
Silver	6.0	0.4 U	0.4 U	0.4 U	0.5	0.3 J	0.6	
Zinc	410	100	127	72	119	87	151	
Organics (ug/kg)								
Total LPAH[1][2]	5,200	1,512	1,490	1,533	2,511	3,677	1,344	
Naphthalene	2,100	87	82	92	318	600	36	
Acenaphthylene	1,300	55	78	31	84	57	110	
Acenaphthene	500	125	120	130	466	**890**	42	
Fluorene	540	125	110	140	333	**610**	56	
Phenanthrene	1,500	830	820	840	955	1,200	710	
Anthracene	960	290	280	300	355	320	390	
2-Methylnaphthalene	670	35	37 U	32	45	68	22	
Total HPAH[2]	12,000	7,067	7,685 J	6,449	6,729	5,234	8,223	3
Fluoranthene	2,500	1,500	1,900	1,100	1,205	810	1,600	
Pyrene	3,300	1,130	960	1,300	875	790	960	
Benz(a)anthracene	1,600	465	390	540	620	460	780	
Chrysene	2,800	725	710	740	1,170	740	1,600	
Benzo(b)fluoranthene	---	1,110	1,300	920	945	790	1,100	
Benzo(k)fluoranthene	---	685	790	580	660	600	720	
Benzofluoranthenes (b+k)[3]	3,600	1,795	2,090	1,500	1,605	1,390	1,820	
Benzo(a)pyrene	1,600	660	690	630	725	540	910	
Indeno(1,2,3-c,d)pyrene	690	360	420	300	270	240	300	
Dibenz(a,h)anthracene	230	82	95	69	64	54	73	
Benzo(g,h,i)perylene	720	350	430 J	270	195	210	180	
Chlorinated Hydrocarbons (ug/kg)								
1,2,4-Trichlorobenzene	---	37 U	37 U	na	19 U	19 U	na	
1,2-Dichlorobenzene	---	37 U	37 U	na	19 U	19 U	na	
1,3-Dichlorobenzene	---	37 U	37 U	na	19 U	19 U	na	
1,4-Dichlorobenzene	---	37 U	37 U	na	19 U	19 U	na	
Hexachlorobenzene (HCB)	22	15 Y	25 U	15 Y	18 Y	18 U	18 Y	
Phthalates (ug/kg)								
Dimethyl phthalate	160	20 U	37 U	20 U	20 U	19 U	20 U	
Diethyl phthalate	200	20 U	37 U	20 U	20 U	19 U	20 U	
Di-n-butyl phthalate	1,400	20 U	37 U	20 U	20 U	19 U	20 U	
Butyl benzyl phthalate	900	20 U	37 U	20 U	20 U	19 U	20 U	
Bis(2-ethylhexyl) phthalate	1,300	220	260	180	265	230	300	
Di-n-octyl phthalate	6,200	20 U	37 U	20 U	20 U	19 U	20 U	
Phenols (ug/kg)								

2 - al	Segment 2 - Subtidal			Segment 3 - Intertidal	Segment 3 - Subtidal			Segment 4 - Intertidal	Segment 4 - Subtidal
0	Average	Feb-00	Jun-00	Feb-00	Average	Feb-00	Jun-00	Feb-00	Feb-00
	56	55	56	78	56	72	39	75	66
	13	NA	13	NA	22	NA	22	NA	NA
	55	NA	55	NA	12	NA	12	NA	NA
	17	NA	17	NA	33	NA	33	NA	NA
	15	NA	15	NA	33	NA	33	NA	NA
	2.4	2.5	2.2	1.5	2.4	1.3	3.4	1.2	1.6
R	nc	R	4 U	R	nc	R	6 U	R	R
	12	13	11	6	12	6	18	7	10
U	0.4	0.3	0.4	0.2 U	0.4	0.3	0.5	0.3 U	0.3
J	122	154 J	89	2,350 J	973	1,880 J	65	2,610 J	82 J
	71	73	69	33	73	34	111	26	45
	77	84	70	33	66	41	90	28	38
	0.14	0.13	0.15	0.04	0.16	0.09	0.23	0.04	0.08
J	22	21 J	22	35 J	33	37 J	28	40 J	18 J
U	0.4	0.3 J	0.4	0.4 U	0.4	0.2 U	0.5	0.4 U	0.2 U
	157	128	186	106 J	142	66	218	63	83
	2,245	2,590	1,900	818	2,183	2,180	2,185	655	1,566
U	86	100	71 U	18 J	45	30	59	50	19 U
	120	130	110	53	180	160	200	44	72
U	125	140	110	40	103	110	96	24	29
	150	160	140	47	160	160	160	34	75
	1,400	1,700	1,100	500	1,105	1,300	910	420	1,200
	400	360	440	160	590	420	760	83	190
U	36	27	45	19 U	38	24	52	85	19 U
	13,161	12,752	13,570	6,168	20,950	20,920	20,980	4,283	8,775
	3,150	3,100	3,200	950 J	4,400	4,600	4,200	930	2,300
	2,350	2,700	2,000	1,100	3,050	3,800	2,300	920	1,800
	920	840	1,000	410	1,750	1,800	1,700	230	610
	1,850	1,700	2,000	800 J	2,750	2,700	2,800	540	1,100
	1,600	1,600	1,600	800 J	2,800	2,700	2,900	540	1,200
	1,350	1,300	1,400	680	2,250	2,400	2,100	390	760
	2,950	2,900	3,000	1,480	5,050	5,100	5,000	930	1,960
	970	840	1,100	490	1,850	1,600	2,100	270	560
	450	330	570	430	965	630	1,300	210	210
	151	72	230	88	335	190	480	43	55 J
J	370	270	470	420 J	800	500	1,100	210 J	180
J	19 U	19 U	na	19 U	19 U	19 U	na	19 U	19 U
J	19 U	19 U	na	19 U	19 U	19 U	na	19 U	19 U
J	19 U	19 U	na	19 U	19 U	19 U	na	19 U	19 U
J	19 U	19 U	na	19 U	19 U	19 U	na	19 U	19 U
	11	11 U	10	5 U	7	4 U	10	2	1 U
J	19 U	19 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U
J	19 U	19 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U
	19 U	19 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U
	24	18 J	29	38	67	23	110	27	19 U
	370	260	480	130 U	870	440	1,300	97 U	180 U
J	19 U	19 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U

Table 4. Results of individual replicates in 10-day amphipod (*E. estuarius*) toxicity test

	Replicate Percent Survival					Mean Percent Survival
	A	B	C	D	E	
Reference Samples						
Negative Control	100	100	100	100	100	100
CR-24	95	100	100	95	100	98
CR-23W	100	100	95	100	100	99
Test Samples						
MHB-034	95	90	90	90	85	90
MHB-035	90	100	95	95	90	94
MHB-036	80	85	80	85	85	83

Table 5. Results of individual replicates in 48-hour bivalve (*M. galloprovincialis*) larval toxicity test

	Replicate Percent Normal Survival					Mean Percent Normal Survival
	A	B	C	D	E	
Reference Samples						
Negative Control	92.4	99.0	96.2	91.7	97.9	95.4
CR-24	77.6	73.4	71.7	77.9	67.6	73.7
CR-23W	58.6	60.7	54.8	62.4	56.6	58.6
Test Samples						
MHB-034	69.0	73.1	69.3	65.9	61.0	67.7
MHB-035	75.5	72.8	77.9	79.7	70.3	75.2
MHB-036	61.4	65.2	58.6	68.6	57.2	62.2

Table 6. Results of individual replicates in 20-day juvenile polychaete (*N. arenaceodentata*) toxicity test

	Growth Rate (mg/individual/day dry weight)					Mean Growth Rate (mg/individual/day dry weight)
	A	B	C	D	E	
Reference Samples						
Negative Control	0.66	1.11	0.66	0.61	0.66	0.83
CR-24	0.97	0.90	0.76	0.68	0.75	0.81
CR-23W	0.62	0.86	0.93	1.05	0.82	0.86
Test Samples						
MHB-034	0.52	0.75	0.88	0.72	0.84	0.74
MHB-035	0.96	0.53	0.82	0.70	0.72	0.75
MHB-036	0.64	0.69	0.58	0.54	0.58	0.61

Table 7. Ammonia-N and total sulfide concentrations in 10-day amphipod (*E. estuarius*) toxicity tests

	Ammonia-N (mg/L)				Sulfide (mg/L)[c]		
	Pre-Test[a]	Test[b] Day 0 (test initiation)	Test[b] Day 5	Test[b] Day 10	Pre-Test[a]	Test Day 0	Test Day 10
Reference Samples							
Negative Control	---	1.11	<0.71[d]	<0.88[d]		<0.02	<0.02
CR-24	18.49	7.56	4.28	3.31	<0.2	0.05	<0.02
CR-23W	14.70	8.01	4.73	6.71	28	<0.02	<0.02
Test Samples							
MHB-034	24.82	10.66	5.63	<2.64[d]	<0.2	0.04	<0.02
MHB-035	28.55	18.17	10.14	3.31	<0.2	<0.02	<0.02
MHB-036	28.55	19.49	9.69	5.80	<0.2	0.02	0.02

Notes: (a) Interstitial sediment porewater concentrations measured in bulk sediments prior to test set-up.
(b) Interstitial sediment porewater concentrations measured in sacrificial test beakers.
(c) Concentrations in overlying water.
(d) Ammonia-N values reported as "<" are based on method detection limit (0.10 mg/L N) and dilution factor.

Table 8. Summary of control and reference station results in amphipod (*E. estuarius*) toxicity tests and comparison to performance criteria

Sample ID	Percent Fines in Sediments	Maximum Observed Interstitial Ammonia-N	Percent Survival[a]	Performance Criteria Met?
Negative Control				
Performance criterion			> 90	
Test performance			100	Yes
Reference Sediment				
Performance criterion			> 75	
CR-24	70	7.56 mg/L	98.0±2.7	Yes
CR-23W	36	8.01 mg/L	99.0±2.2	Yes

Notes: (a) Mean ± standard deviation for five replicate samples.

Table 9. Summary of the results of the amphipod (*E. estuarius*) toxicity tests and comparison to SMS criteria

Station	Test Results			Reference Sediment For SMS Comparison	Sediment Quality Standard (SQS) Criteria		Cleanup Screening Level (CSL) Criteria		SMS Conclusion
	Percent Fines	Maximum Observed Interstitial Ammonia-N	Percent Survival[a]		The test sediment has a lower[b] mean survival than the reference sediment	The test sediment mean survival is less than 75 percent, on an absolute basis	The test sediment has a lower[b] mean survival than the reference sediment	The test sediment mean survival is lower than the reference sediment mean survival minus 30 percent	
MHB-034	58	10.66 mg/L	90.0±3.5	CR-24	Yes	No	Yes	No	PASS
MHB-035	32	18.17 mg/L	94.0±4.2	CR-23W	Yes	No	Yes	No	PASS
MHB-036	66	19.49 mg/L	83.0±2.7	CR-24	Yes	No	Yes	No	PASS

Notes: (a) Mean ± standard deviation for five replicate samples.
(b) Statistically significant, t-test, $p \leq 0.05$

Table 10. Ammonia-N and total sulfide concentrations in 48-hour larval bivalve (*M. galloprovincialis*) toxicity tests

	Ammonia-N (mg/L)[a]	Sulfide (mg/L)[a]	
	Test Hour 0 (test initiation)	Test Hour 0	Test Hour 48
Reference Samples			
Negative Control	<0.10	<0.02	<0.02
CR-24	0.30	<0.05	<0.02
CR-23W	0.18	<0.05	<0.02
Test Samples			
MHB-034	<0.10	<0.02	<0.02
MHB-035	0.36	0.03	<0.02
MHB-036	0.34	<0.05	<0.02

Table 11. Summary of control and reference station results in larval bivalve (*M. galloprovincialis*) toxicity tests and comparison to performance criteria

Sample ID	Percent Fines in Sediments	Percent Normal Survival[a]	Net Percent Normal Survival[b]	Performance Criteria Met?
Negative Control				
Performance criterion		≥ 70		
Test performance		95.4±3.2		Yes
Reference Sediment				
Performance criterion			≥ 65% of control	
CR-24	70	73.7±4.3	77.3	Yes
CR-23W	36	58.6±3.1	61.4	No

Notes: (a) Mean ± standard deviation for five replicate samples.
(b) Mean for five replicate samples. Value standardized to negative control survival by dividing actual test sediment survival by the negative control survival.

Table 12. Summary of the results of the larval bivalve (*M. galloprovincialis*) toxicity tests and comparison to SMS criteria

Station	Test Results			Reference Sediment For SMS Comparison	Sediment Quality Standard (SQS) Criteria		Cleanup Screening Level (CSL) Criteria		SMS Conclusion
	Percent Fines	Percent Normal Survival in Test Sediment[a]	Net Percent Normal Survival[b]		The test sediment has a mean survivorship of normal larvae that is less than[c] the mean normal survivorship in the reference sediment	The test sediment mean normal survivorship is less than 85 percent of the mean normal survivorship in the reference sediment[d]	The test sediment has a mean survivorship of normal larvae that is less than[c] the mean normal survivorship in the reference sediment	The test sediment mean normal survivorship is less than 70 percent of the mean normal survivorship in the reference sediment[e]	
MHB-034	58	67.7±4.5	71.0	CR-24	Yes	No	Yes	No	PASS
MHB-035	32	75.2±3.8	78.8	Negative Control[f]	Yes	Yes	Yes	No	SQS
MHB-036	66	62.2±4.7	65.2	CR-24	Yes	Yes	Yes	No	SQS

Notes:
(a) Mean ± standard deviation for five replicate samples.
(b) Mean for five replicate samples. Value standardized to negative control survival by dividing actual test sediment survival by the negative control survival.
(c) Statistically significant, t-test, $p \leq 0.10$
(d) This SQS criterion is exceeded when the mean normal survivorship in the test sediment is less than the value represented by the reference sediment mean normal survivorship minus 15 percent.
(e) This CSL criterion is exceeded when the mean normal survivorship in the test sediment is less than the value represented by the reference sediment mean normal survivorship minus 30 percent.
(f) Reference sample CR-23W did not meet performance criteria; therefore, the negative control was used (conservatively) for comparison to SMS criteria.

Table 13. Ammonia-N and total sulfide concentrations in 20-day juvenile polychaete (*N. arenaceodentata*) toxicity tests

	Ammonia-N (mg/L)[a]			Sulfide (mg/L)[b]	
	Test Day 0 (test initiation)	Test Day 10	Test Day 20	Test Day 0	Test Day 20
Reference Samples					
Negative Control	<0.75	2.69	3.47	<0.02	<0.02
CR-24	6.94	2.86	<1.13	0.03	<0.02
CR-23W	5.49	8.97	1.74	0.03	<0.02
Test Samples					
MHB-034	10.35	5.57	2.10	0.05	<0.02
MHB-035	18.13	8.51	2.74	0.05	<0.02
MHB-036	14.24	6.93	<1.13	0.04	<0.02

Notes: (a) Interstitial sediment porewater concentrations measured in sacrificial test beakers. Ammonia-N values reported as "<" are based on method detection limit (0.10 mg/L N) and dilution factor.

(b) Concentrations in overlying water.

Table 14. Summary of control and reference station results in juvenile polychaete (*N. arenaceodentata*) toxicity tests and comparison to performance criteria

SAMPLE ID	PERCENT FINES IN SEDIMENTS	MEAN INDIVIDUAL GROWTH RATE (MIG)[a] (mg/ind/day, dry weight)	PERCENT SURVIVAL[b]	PERFORMANCE CRITERIA MET?
Negative Control				
Performance criterion		0.38[d]	≥ 90	
Test performance		0.83±0.20	92±11.0	Yes
Reference Sediment				
Performance criterion		80% of control MIG		
CR-24	70	0.81±0.12 (98% of control MIG)	96±8.9	Yes
CR-23W	36	0.86±.016 (103% of control MIG)	100	Yes

Notes: (a) Value based on control growth rates per SMARM (1996).
(b) Mean ± standard deviation for five replicate samples.

Table 15. Summary of the results of the juvenile polychaete (*N. arenaceodentata*) toxicity tests and comparison to SMS criteria

STATION	TEST RESULTS			REFERENCE SEDIMENT FOR SMS COMPARISON	SEDIMENT QUALITY STANDARD (SQS) CRITERIA		CLEANUP SCREENING LEVEL (CSL) CRITERIA		SMS CONCLUSION
	PERCENT FINES	MEAN INDIVIDUAL GROWTH RATE IN TEST SEDIMENT[a] (mg/ind/day)	PERCENT SURVIVAL[a]		The test sediment has a MIG[b] of less than 70 percent of the reference sediment MIG	The test sediment MIG is statistically different (t-test, p≤0.05) from the reference sediment MIG	The test sediment has a MIG of less than 50 percent of the reference sediment MIG	The test sediment MIG is statistically different (t-test, p≤0.05) from the reference sediment MIG	
MHB-034	58	0.74±0.14	96.0±8.9	CR-24	No	No	No	No	PASS
MHB-035	32	0.75±0.16	96.0±8.9	CR-23W	No	No	No	No	PASS
MHB-036	66	0.61±0.06	100.0	CR-24	No	Yes	No	Yes	PASS

Notes: (a) Mean ± standard deviation for five replicate samples.
(b) MIG = mean individual growth rate

Table 16. Summary of the three biological toxicity tests results as compared to SMS criteria

Station	Amphipod		Larval Bivalve		Juvenile Polychaete		Overall Conclusion	
	SQS	CSL	SQS	CSL	SQS	CSL	SQS	CSL
MHB-034	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
MHB-035	PASS	PASS	FAIL	PASS	PASS	PASS	FAIL	PASS
MHB-036	PASS	PASS	FAIL	PASS	PASS	PASS	FAIL	PASS

APPENDIX A
Phase 1 Field Activities Report

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FIELD ACTIVITIES REPORT

CHARACTERIZATION OF THE NAVY BANK AREA PHASE I HYLEBOS MOUTH CLEANUP

PORT OF TACOMA/OCCIDENTAL CHEMICAL CORPORATION TACOMA, WASHINGTON

FEBRUARY 2000
REF. NO. 15403 (2)

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1.0 INTRODUCTION

The Port of Tacoma (POT) and Occidental Chemical Corporation (OxyChem) are cooperatively conducting a preliminary characterization of the bank and side-slope areas adjacent to the Navy and Marine Corps Reserve property located on Alexander Avenue in Tacoma, Washington. This work is being performed as part of the Phase I Hylebos Mouth Cleanup.

The purpose of this preliminary characterization is to assess the chemical and physical characteristics of the bank and side-slope areas and determine whether active remediation is needed.

Samples were collected from the bank and side-slope along the Navy property on February 16 and 17, 2000 and the samples were submitted for chemical and physical analyses. The sample collection and analyses were performed in accordance with a Work Plan and Sampling and Analysis Plan based on the approaches and procedures implemented in other bank investigations along the Waterway; namely, the Pre-Remedial Design Study for the Port of Tacoma Industrial Yard and the Embankment Area Removal Action of the Former OxyChem Tacoma facility.

This report presents an overview of the project, a summary of the field activities conducted February 16 and 17, 2000, the project Sampling and Analysis Plan (SAP), and the project Quality Assurance Project Plan (QAPP). The report is organized as follows:

- Section 1.0 - Introduction: The introduction describes the project background and purpose;
- Section 2.0 - Site Background: Descriptions of the Site location and previous investigations are presented in Section 2.0;
- Section 3.0 - Sample Locations and Depths: The locations and depths of the samples collected are described in Section 3.0;
- Section 4.0 - Sample Collection and Processing: The procedures for sample collection and processing are presented in Section 4.0;
- Section 5.0 - Sample Analyses and Physical Testing: The chemical analyses and physical tests performed on the samples collected are described in Section 5.0;
- Section 6.0 - Health and Safety: The health and safety requirements for the field activities are described in Section 6.0;
- Section 7.0 - Reporting: The reports which will be prepared following receipt of the analytical and testing data are described in Section 7.0; and
- Section 8.0 - Schedule: The project schedule is presented in Section 8.0.

2.0 SITE BACKGROUND

2.1 SITE LOCATION

The Navy and Marine Corps Reserve property (the Property) is located along the Hylebos Waterway at 1100 E. Alexander Avenue in Tacoma, Washington. The bank and side-slope adjacent to the Property between the elevations of 11 feet mean lower low water (MLLW) and -30 feet MLLW, are collectively referred to as the Navy Bank. The location of the Navy Bank is shown on Figure 2.1.

2.2 PREVIOUS INVESTIGATIONS

In 1994 and 1998, during the Hylebos Waterway Pre-Remedial Design Program (Hylebos PRD) conducted by the Hylebos Cleanup Committee (HCC), two samples of sediment from the vicinity of the Navy Bank were collected and analyzed. The samples collected were from the intertidal and subtidal zones. The samples were collected at elevations of approximately 0 feet MLLW (intertidal composite Station 5212I) and -10 feet MLLW (subtidal Station 5134), respectively. The locations of these samples are shown on Figure 2.2.

The Hylebos PRD samples were analyzed for the constituents listed in Table 2.1. The results of the analyses of these two samples are contained in Appendix A. The only chemical that exceeded Sediment Quality Objectives (SQOs) and Sediment Remedial Action Levels (SRALs) in the intertidal zone (Station 5212I) was ethylbenzene. This sample was composed primarily of coarse-grained materials, with less than 5 percent fines (silt + clay). The subtidal sample (Station 5134), composed of slightly finer-grained material (approximately 16 percent fines), contained a range of polynuclear aromatic hydrocarbons (PAHs) and other semi-volatile organic compounds (SVOCs) that exceeded SQOs and SRALs. Chemical data for these samples are summarized in Table A1 of Appendix A. Confirmatory biological testing performed on these samples verified that both samples exceeded Minimum Cleanup Level (MCL) interpretation criteria. However, given the fact that the subtidal station (5134) was outside of the Navy's property boundary, and that the intertidal station (5212I) extended beyond the Navy's property boundary, there is uncertainty relating to the extent of contamination in the vicinity of the Navy bank.

TABLE 2.1

ANALYTICAL PARAMETERS AND CRITERIA
NAVY BANK AREA CHARACTERIZATION

Parameter	*CAS Number*	*SQO (µg/Kg)*
Volatiles (Method 8260)		
Trichloroethene	79-01-6	-
Tetrachloroethene	127-18-4	57
Ethylbenzene	100-41-4	10
Total Xylenes	1330-20-7	40
Semi-Volatiles (Method 8270)		
Phenol	108-95-2	420
1,3-Dichlorobenzene	541-73-1	170
1,4-Dichlorobenzene	106-46-7	110
1,2-Dichlorobenzene	95-50-1	50
2-Methylphenol	95-48-7	63
4-Methylphenol	106-44-5	670
Hexachloroethane	67-72-1	-
2,4-Dimethylphenol	105-67-9	29
1,2,4-Trichlorobenzene	120-82-1	51
Naphthalene	91-20-3	2,100
Hexachlorobutadiene	87-68-3	11
2-Methylnaphthalene	91-57-6	670
Dimethylphthalate	131-11-3	160
Acenaphthylene	208-96-8	1,300
Acenaphthene	83-32-9	500
Dibenzofuran	132-64-9	540
Diethylphthalate	84-66-2	200
Fluorene	86-73-7	540
n-Nitrosodiphenylamine	86-30-6	28
Hexachlorobenzene	118-74-1	22
Pentachlorophenol	87-86-5	360
Phenanthrene	85-01-8	1,500
Anthracene	120-12-7	960
Di-n-butylphthalate	84-74-2	1,400
Fluoranthene	206-44-0	2,500
Pyrene	129-00-0	3,300
Butyl benzyl phthalate	85-68-7	900
Benzo(a)anthracene	56-55-3	1,600
Chrysene	218-01-9	2,800
bis(2-Ethylhexyl)phthalate	117-81-7	1,300
Di-n-octyl phthalate	117-84-0	6,200
Benzo(b)fluoranthene	205-99-2	(1)

TABLE 2.1

ANALYTICAL PARAMETERS AND CRITERIA
NAVY BANK AREA CHARACTERIZATION

Parameter	*CAS Number*	*SQO (µg/Kg)*
Benzo(k)fluoranthene	207-08-9	(1)
Semi-Volatiles (Method 8270) (Cont'd.)		
Benzo(b+k)fluoranthene	-	360
Benzo(a)pyrene	50-32-8	1,600
Indeno(1,2,3-cd)pyrene	193-39-5	690
Dibenzo(a,h)anthracene	53-70-3	230
Benzo(g,h,i,)perylene	191-24-2	720
Benzyl alcohol	100-51-6	73
Benzoic acid	65-85-0	650
Pesticides/PCBs (Method 8081)		
gamma-BHC (Lindane)	58-89-9	-
Heptachlor	76-44-8	-
Aldrin	309-00-2	-
Dieldrin	60-57-1	-
4,4'-DDE	72-55-9	9
4,4'-DDD	72-54-8	16
4,4'-DDT	50-29-3	34
alpha-Chlordane	5103-71-9	-
gamma-Chlordane	5103-74-2	-
Total PCBs (Method 8082)	1336-33-3	300
Metals		
Antimony (Method 6010A)	7440-36-0	150,000
Arsenic (Method 6010A)	7440-38-2	57,000
Cadmium (Method 6010A)	7440-43-9	5,100
Copper (Method 6010A)	7440-50-8	390,000
Lead (Method 6010A)	7440-92-1	450,000
Mercury (Method 7470A)	7440-97-6	590
Nickel (Method 6010A)	7440-02-0	140,000
Silver (Method 6010A)	7440-22-4	6,100
Zinc (Method 6010A)	7440-66-6	410,000
General		
TOC	-	-

Notes:

-	No standard.
(1)	Total benzo(b&k) fluoranthenes 3600 µg/Kg.
PCBs	Polychlorinated Biphenyls.
SQO	Sediment Quality Objective.

3.0 SAMPLE LOCATIONS AND DEPTHS

The work performed consisted of sampling and analysis of surface sediment (0 to 10 centimeters [cm]) from the bank and side-slope. The sampling locations and sample depths are described in the following subsections.

3.1 GENERAL

The Navy Bank was divided into eight grid areas as shown on Figure 3.1. With the exception of samples to be analyzed for volatile organic compounds (VOCs), the samples collected within each grid section were composited to obtain one analytical sample. Discrete samples were submitted for VOC analyses. The sample locations are shown on Figure 3.1.

Sample locations were moved as necessary based on observed characteristics of the sediment (i.e., color, odor, etc.) or physical characteristics of the bank. Samples were collected only where sufficient sediment material existed. If riprap or other obstructions prevented sufficient sample volume from being collected at an intended location, the sample location was adjusted.

Sample locations were surveyed or were tied by field measurements to surveyed reference points. An accurate sample location plan is being prepared and will be presented with the analytical data in a subsequent report.

A sample summary is presented in Table 3.1.

3.2 BANK SAMPLES

Bank samples were collected within the intertidal zone, between the elevations of 11 feet MLLW and 0 feet MLLW, at four locations within each grid section.

3.3 SIDE-SLOPE

Side-slope samples were collected from the subtidal zone, between the elevations of 0 feet MLLW and -30 feet MLLW, at two locations within each grid section.

TABLE 3.1

SAMPLE SUMMARY
NAVY BANK AREA CHARACTERIZATION
FEBRUARY 2000

Sample Location	*Sample ID*	*Sample Date*	*Sample Time*	*Sample Set*	*Comments*	*Description*
1IA	SE-021600-JSV-001	02/16/00	19:45	(1)		SP-gravelly sand, brown to black, trace shells
1IB		02/16/00	19:55	(2)		SP-sand, medium to fine grained, brown
1IC		02/16/00	20:05	(2)		SP-gravelly sand, brown to black, trace shells
1ID	SE-021600-JSV-002	02/16/00	20:10	(1)		SP-sand, coarse grained, some gravel, brown
Composite	SE-021600-JSV-018	02/16/00	19:45	(3)		composite of 1Ia, 1Ib, 1Ic, and 1Id
2IA	SE-021600-JSV-003	02/16/00	20:20	3 x (1)	MS/MSD	SP-sand, medium to fine grained, brown, trace to little silt and gravel
2IB		02/16/00	20:30	(2)		SP-sand, coarse grained, some gravel, brown
2IC		02/16/00	20:35	(2)		SP-gravelly sand, brown
2ID	SE-021600-JSV-004	02/16/00	20:40	(1)		SP-gravelly sand, brown, trace silt
Composite	SE-021600-JSV-019	02/16/00	20:20	3 x (3)	MS/MSD	composite of 2Ia, 2Ib, 2Ic, and 2Id
3IA	SE-021600-JSV-005	02/16/00	20:50	(1)		SP-sand, coarse to medium grained, brown, some to little gravel
3IB		02/16/00	20:53	(2)		SP-sand, coarse to medium grained, brown, some to little gravel
3IC		02/16/00	20:55	(2)		SP-gravelly sand, trace to little silt, brown
3ID	SE-021600-JSV-006	02/16/00	21:00	(1)		SP-sand and gravel, brown
3ID	SE-021600-JSV-017	02/16/00	12:00	(1)	Dup of 006	
Composite	SE-021600-JSV-020	02/16/00	20:50	(3)		composite of 3Ia, 3Ib, 3Ic, and 3Id
Composite	SE-021600-JSV-026	02/16/00	12:00	(3)	Dup of 020	composite of 3Ia, 3Ib, 3Ic, and 3Id
4IA	SE-021600-JSV-007	02/16/00	21:15	(1)		SP-sand and gravel, brown
4IB		02/16/00	21:20	(2)		SP-sand and gravel, brown
4IC		02/16/00	21:25	(2)		SP-sand, coarse to medium grained, some gravel, brown
4ID	SE-021600-JSV-008	02/16/00	21:30	(1)		SP-sand, coarse to medium grained, some gravel, trace silt, brown
Composite	SE-021600-JSV-021	02/16/00	21:15	(3)		composite of 4Ia, 4Ib, 4Ic, and 4Id
1SB		02/17/00	14:00	(2)		ML-silt, trace to little sand, trace to little shells, grey-black
1SD	SE-021700-JSV-016	02/17/00	13:45	(1)		GM-silt and gravel, some fine sand, grey-black
Composite	SE-021700-JSV-029	02/17/00	13:45	(3)		composite of 1Sb and 1Sd
		02/17/00	13:40	(2)		GM-silt and gravel, some fine sand, grey-black
	SE-021700-JSV-015	02/17/00	13:30	(1)		ML-silt, trace to little sand, trace to little shells, grey-black
Composite	SE-021700-JSV-030	02/17/00	13:30	(3)		composite of 2Sb and 2Sd
3SB		02/17/00	10:55	(2)		ML-SP- silt and sand, coarse to fine grained, trace shells, grey-black
3SD	SE-021700-JSV-014	02/17/00	16:00	(1)		SP-sand and gravel, trace silt, trace shells, black
Composite	SE-021700-JSV-031	02/17/00	15:45	(3)		composite of 3Sb and 3Sd
4SB		02/17/00	11:10	(2)		ML-SP-silt and fine sand, some to little shells
4SD	SE-021700-JSV-013	02/17/00	15:00	(1)		SP-gravel and coarse sand, black
Composite	SE-021700-JSV-032	02/17/00	15:30	(3)		composite of 4Sb and 4Sd
	RB-021600-JSV-027	02/16/00	18:00	(4)	Rinse Blank	
	RB-021700-JSV-028	02/17/00	9:00	(4)	Rinse Blank	
	Trip Blank	02/18/00	-	(5)	Trip Blank	

Notes:

(1)	2 x 2oz. VOC soils plus composite sample
(2)	composite sample
(3)	1 x 16oz. ABN/Pest/PCB, 1 x 4oz. Metals, 1 x 4oz. TOC, Total Solids
(4)	2 x 40mL VOC w/HCl, 1 x 1L ABN, 1 x 1L Pest/PCB, 1 x 1L Metals w/HNO3
(5)	6 x 40mL VOC w/HCl
VOA	Volatile Organic Compounds
Pest	Pesticides
PCB	Polychlorinated Biphenols
TOC	Total Organic Carbon

4.0 SAMPLE COLLECTION AND PROCESSING

Samples were collected at each of the locations within the eight grid sections. Two samples were collected at half of the locations; one sample for discrete analyses of VOCs and one sample which was composited with the other grid section samples for analyses of the remaining parameters. The samples were composited and homogenized in accordance with the procedures contained in Appendix B. Following homogenization, aliquots were removed and submitted for analysis.

4.1 SAMPLE COLLECTION

All samples were collected in accordance with the procedures for collection and handling presented in the Sampling and Analysis Plan (SAP) contained in Appendix B.

4.1.1 BANK SAMPLES

The surface of the bank is covered with riprap and rock. Therefore, bank samples were collected by hand using small sampling equipment and hand tools. The lower samples from the bank were collected during lower low tide conditions. All bank samples were collected at times when the sample location was exposed (i.e., the tide level is lower than the sample elevation). In this way it was possible to examine the bank cover and select locations that are most representative of the exposed sediment.

Each sample point was marked and tied with field measurements to a reference point at the time of sampling. The locations or reference points were later surveyed using a differential global positioning system (DGPS) with a horizontal accuracy of $\pm$3 feet. The horizontal datum was Washington State Plane South Zone (NAD 27) coordinates. The elevation of each sample point was surveyed within 0.1 feet. The vertical datum was MLLW.

4.1.2 SIDE-SLOPE SAMPLES

Inspection of the Navy Bank has identified that the riprap and stone covering the bank extends into the side-slope or subtidal area to an estimated elevation of -6 to -8 feet MLLW. These conditions limited the collection of samples from the side-slope.

Side-slope samples were collected from a small boat or from existing dock structures using a modified van Veen sampler. The sampling equipment was lowered and retrieved by hand.

Each sample point was surveyed at the time of sampling using a DGPS with a horizontal accuracy of $\pm$3 feet. The horizontal datum was Washington State Plane South Zone (NAD 27) coordinates. The elevation of each sample point was determined through subtraction of the depth of water at the time of sampling from the water level elevation or, where possible, through direct measurement. Water level elevations were either surveyed at the time of sampling or were based upon the difference between recorded water level elevations at the Navy dock and the depth of water at the sample point. Data from the water level recorder was calibrated to reflect the elevation of water based upon a surveyed reference point. The accuracy of sample point elevations was $\pm$1 foot. The vertical datum was MLLW.

5.0 SAMPLE ANALYSES AND PHYSICAL TESTING

5.1 SAMPLE ANALYSES

Sample analyses are being performed by Analytical Resources Inc. (ARI), a full-service chemical analytical laboratory which participates in the State of Washington Department of Ecology (WDOE) Environmental Laboratory Accreditation Program and is experienced in the analysis of samples using Puget Sound Dredged Disposal Analysis (PSDDA) Guidance.

Samples are being analyzed for the Commencement Bay/Nearshore Tideflats (CB N/T) SQO list of chemicals and total organic carbon. Discrete samples are being analyzed for VOCs and composite samples for the remaining parameters. The analytical parameter list is presented in Table 2.1.

All analyses are being performed in accordance with the Quality Assurance Project Plan (QAPP) contained in Appendix C.

5.2 PHYSICAL TESTING

Physical testing consisting of grain size analysis (American Society for Testing and Materials [ASTM] D-422) will be performed on one composite sample from each grid section.

6.0 HEALTH AND SAFETY

All sampling activities were performed in accordance with a project-specific Health and Safety Plan (HASP). Personal protective equipment (PPE) included the wearing of personal flotation devices at all times work was performed on the bank or dock or from the boat. The "buddy" system was in place at all times; at no time were personnel working in the area unaccompanied. Lighting was supplied by hand held lanterns.

7.0 REPORTING

A Characterization Report that presents the sampling methodology, analytical results, and analytical data quality assurance review will be prepared following receipt and review of the analytical data. Chemical concentrations will be compared to the SQOs and the Sediment Management Standards (SMS) criteria (the SQOs are presented in Table 2.1).

A Technical Memorandum will be prepared which identifies potential cleanup requirements under applicable state and federal cleanup programs. To the extent that potential cleanup requirements are identified, the memo will also include a preliminary analysis of remedial alternatives. The physical conditions at the Site (i.e., slope, condition of bank cover) will be considered with the chemical concentrations in a preliminary comparative analysis of containment and removal alternatives. This will not be an exhaustive evaluation of all potential remedial alternatives, but will provide a preliminary analysis of some potential alternatives that could be applied to the Site. Based on the study findings, a recommended scope and cost to perform additional Site characterization and/or remedial alternative analysis (if necessary) will be included in the Technical Memorandum.

8.0 SCHEDULE

The schedule for the completion of the project activities is presented below.

1.	Sample Collection	February 16 to 17, 2000.
2.	Sample Analyses	Complete March 16, 2000.
3.	Draft Characterization Report	Complete March 24, 2000.
4.	Technical Memorandum	Complete June 2, 2000.

FIGURES

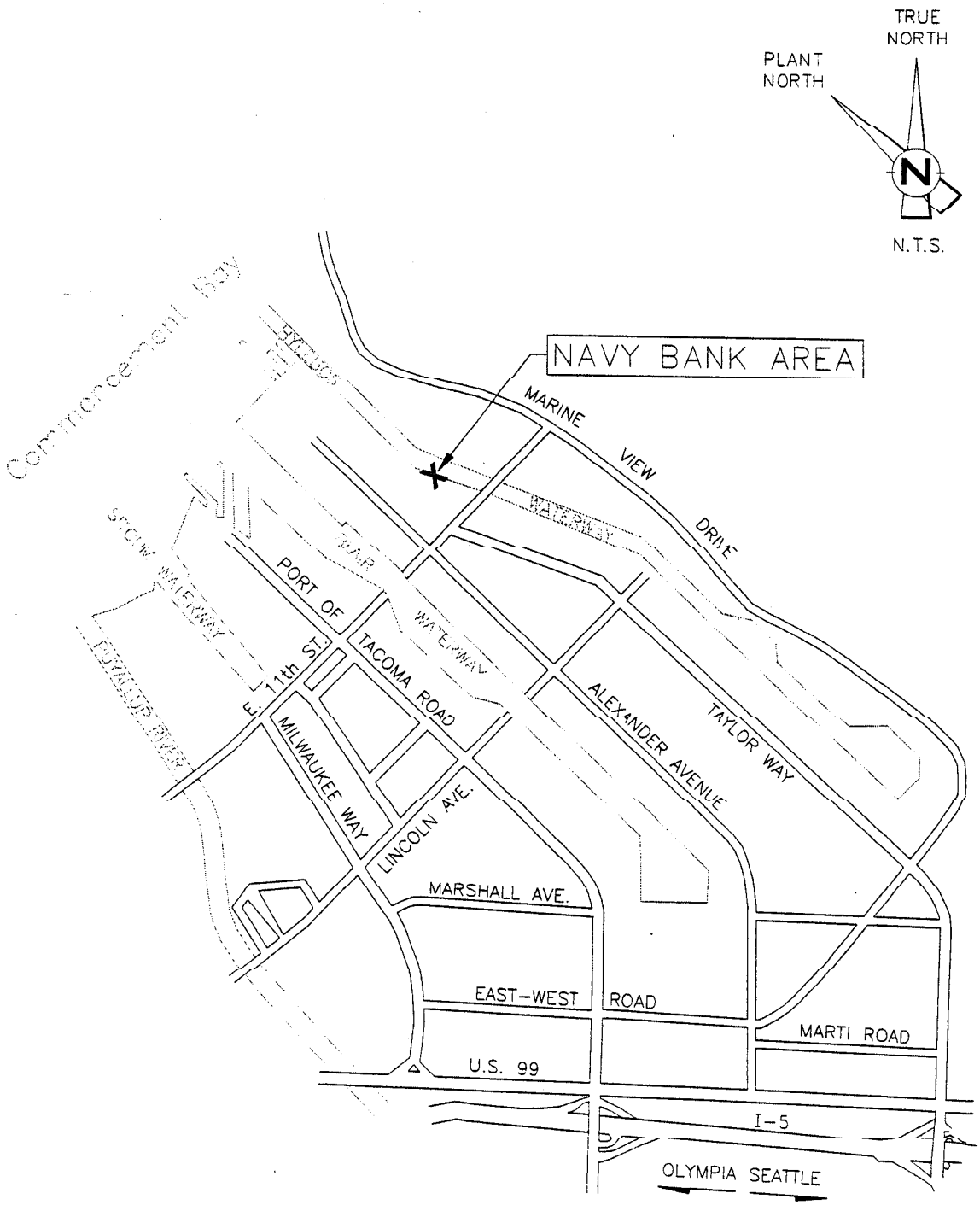
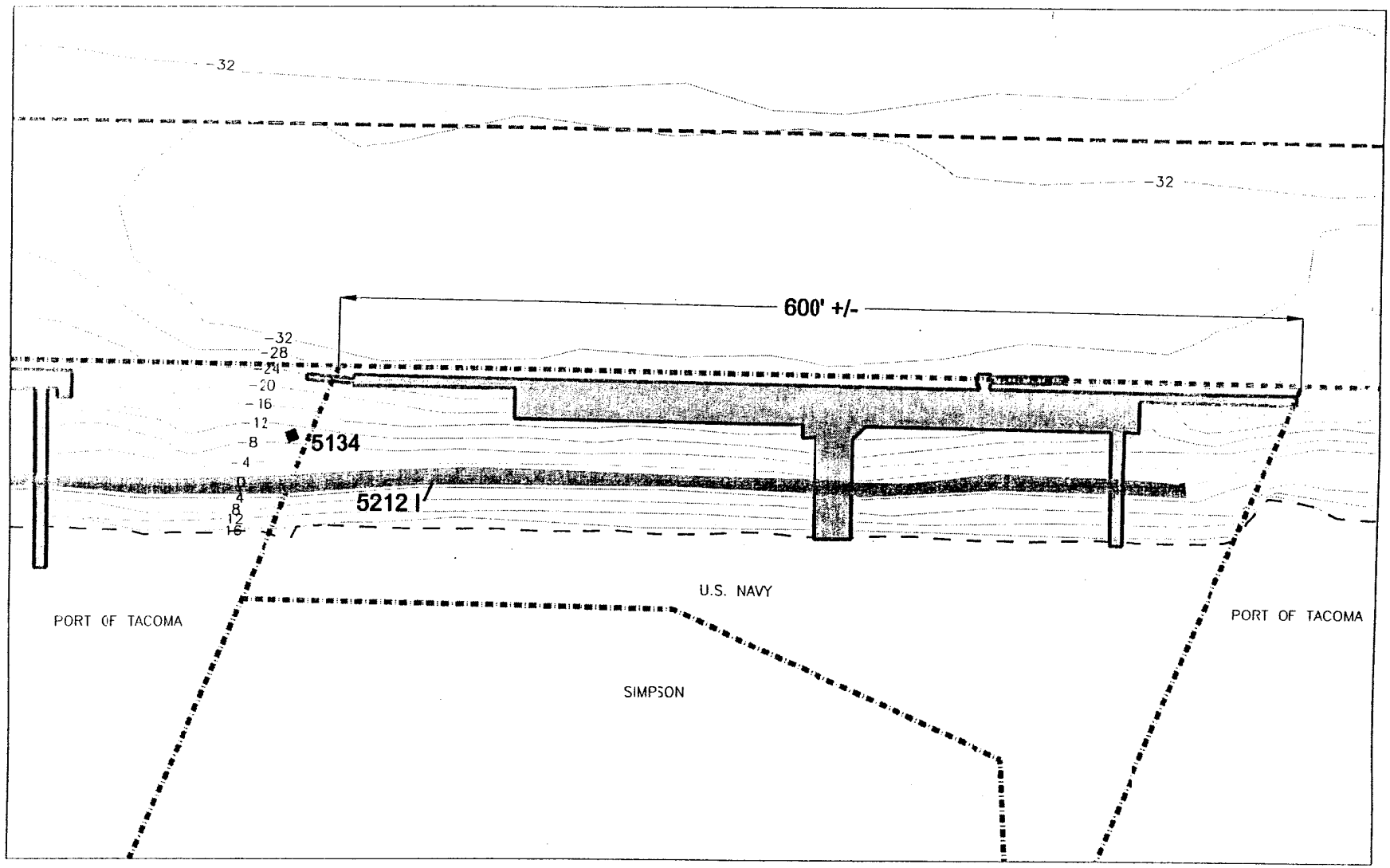


figure 2.1
LOCATION MAP
NAVY BANK AREA CHARACTERIZATION
Port of Tacoma/Occidental Chemical Corporation

CRA



SOURCES:

ANCHOR ENVIRONMENTAL, L.L.C.

LEGEND

AREA COMPOSITED FOR ANALYTICAL SAMPLE

0 30 90ft

figure 2.2

LOCATIONS OF HISTORIC SAMPLES
NAVY BANK AREA CHARACTERIZATION
Port of Tacoma/Occidental Chemical Corporation

CRA

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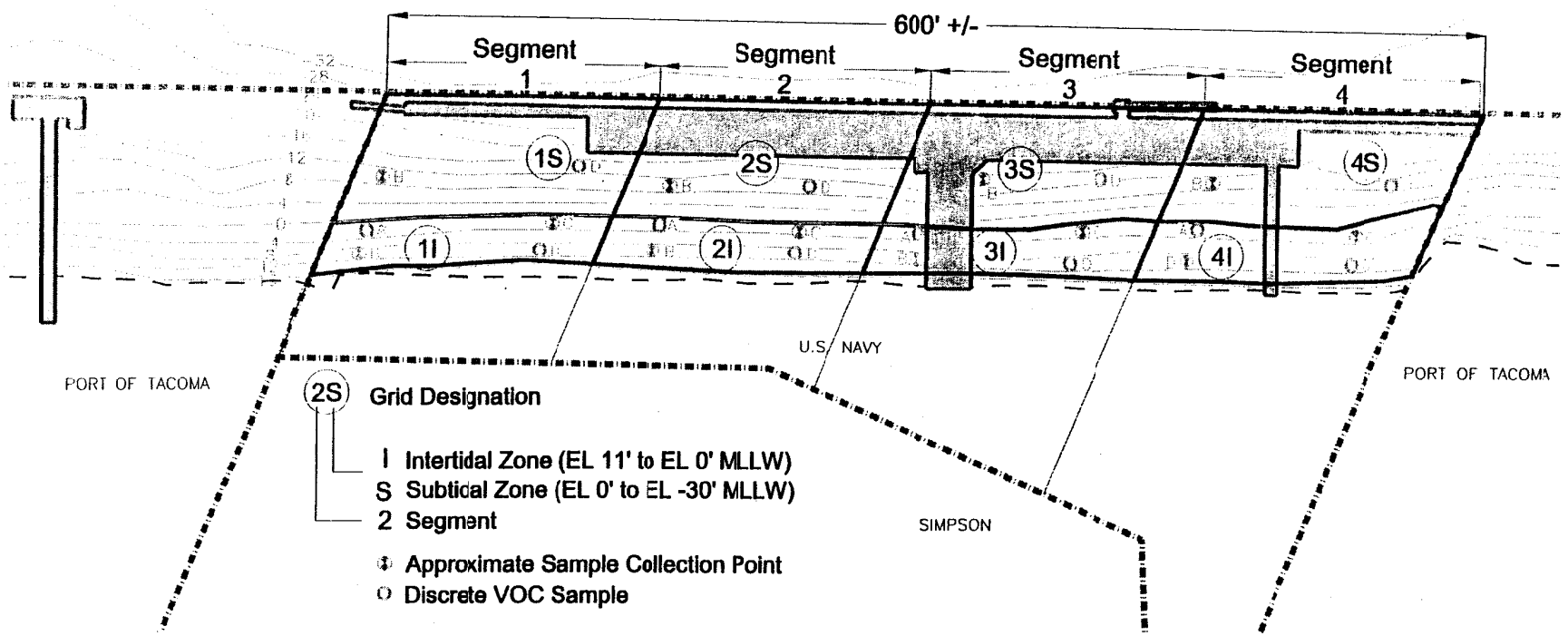

SOURCES:

ANCHOR ENVIRONMENTAL, L.L.C.

GeoEngineers

CRA

NOTE:

THE ACTUAL LOCATIONS AND ELEVATIONS OF SAMPLE COLLECTION POINTS WILL BE PRESENTED IN THE CHARACTERIZATION REPORT.

0 30 90ft

figure 2.3

SAMPLE GRID

NAVY BANK AREA CHARACTERIZATION

Port of Tacoma/Occidental Chemical Corporation

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APPENDIX A

HISTORICAL ANALYTICAL RESULTS

TABLE A1

HISTORIC ANALYTICAL RESULTS
NAVY BANK AREA CHARACTERIZATION

Parameter	*Units*	*CAS Number*	*SQO*	*52121*	*5134*
Volatiles (Method 8260)					
Trichloroethene	µg/Kg	79-01-6	-	1.0 U	0.9 U
Tetrachloroethene	µg/Kg	127-18-4	57	1.0 U	0.9 U
Ethylbenzene	µg/Kg	100-41-4	10	38	0.9 U
Total Xylenes	µg/Kg	1330-20-7	40	25	2.8 U
Semi-Volatiles (Method 8270)					
Phenol	µg/Kg	108-95-2	420	52 U	96
1,3-Dichlorobenzene	µg/Kg	541-73-1	170	26 U	20 U
1,4-Dichlorobenzene	µg/Kg	106-46-7	110	26 U	20 U
1,2-Dichlorobenzene	µg/Kg	95-50-1	50	1.0 U	20 U
2-Methylphenol	µg/Kg	95-48-7	63	26 U	38
4-Methylphenol	µg/Kg	106-44-5	670	26 U	140
Hexachloroethane	µg/Kg	67-72-1	-	52 U	20 U
2,4-Dimethylphenol	µg/Kg	105-67-9	29	26 U	45
1,2,4-Trichlorobenzene	µg/Kg	120-82-1	51	5.1 U	20 U
Naphthalene	µg/Kg	91-20-3	2,100	33 J	8,300
Hexachlorobutadiene	µg/Kg	87-68-3	11	5.1 U	20
2-Methylnaphthalene	µg/Kg	91-57-6	670	26 U	2,000
Dimethylphthalate	µg/Kg	131-11-3	160	26 U	20 U
Acenaphthylene	µg/Kg	208-96-8	1,300	26 U	97
Acenaphthene	µg/Kg	83-32-9	500	43 J	6,300
Dibenzofuran	µg/Kg	132-64-9	540	29 J	3,700
Diethylphthalate	µg/Kg	84-66-2	200	26 U	20 U
Fluorene	µg/Kg	86-73-7	540	43 J	5,600
n-Nitrosodiphenylamine	µg/Kg	86-30-6	28	26 U	20 U
Hexachlorobenzene	µg/Kg	118-74-1	22	16 J	80
Pentachlorophenol	µg/Kg	87-86-5	360	130 U	98 U
Phenanthrene	µg/Kg	85-01-8	1,500	570	36,000
Anthracene	µg/Kg	120-12-7	960	180	8,600
Di-n-butylphthalate	µg/Kg	84-74-2	1,400	26 U	20 U
Fluoranthene	µg/Kg	206-44-0	2,500	1100	52,000
Pyrene	µg/Kg	129-00-0	3,300	1100	34,000
Butyl benzyl phthalate	µg/Kg	85-68-7	900	26 U	20 U
Benzo(a)anthracene	µg/Kg	56-55-3	1,600	430	13,000
Chrysene	µg/Kg	218-01-9	2,800	730	17,000
bis(2-Ethylhexyl)phthalate	µg/Kg	117-81-7	1,300	110	360
Di-n-octyl phthalate	µg/Kg	117-84-0	6,200	26 U	20 U
Benzo(b)fluoranthene	µg/Kg	205-99-2	-	770	13,000
Benzo(k)fluoranthene	µg/Kg	207-08-9	-	630	12,000
Benzo(b+k)fluoranthene	µg/Kg	-	3,600	1400	25,000

TABLE A1

HISTORIC ANALYTICAL RESULTS
NAVY BANK AREA CHARACTERIZATION

Parameter	*Units*	*CAS Number*	*SQO*	*52121*	*5134*
Semi-Volatiles (Method 8270) (Cont'd.)					
Benzo(a)pyrene	µg/Kg	50-32-8	1,600	420	13,000
Indeno(1,2,3-cd)pyrene	µg/Kg	193-39-5	690	320 J	6,700
Dibenzo(a,h)anthracene	µg/Kg	53-70-3	230	110 J	2,200
Benzo(g,h,i,)perylene	µg/Kg	191-24-2	720	100 J	6,100
Benzyl alcohol	µg/Kg	100-51-6	73	26 U	20 U
Benzoic acid	µg/Kg	65-85-0	650	260 U	200 U
Pesticides/PCBs (Method 8081)					
gamma-BHC (Lindane)	µg/Kg	58-89-9	-	0.65 U	3.2 U
Heptachlor	µg/Kg	76-44-8	-	0.65 U	1.9 U
Aldrin	µg/Kg	309-00-2	-	2.3 U	1.9 U
Dieldrin	µg/Kg	60-57-1	-	1.3 U	3.8 U
4,4'-DDE	µg/Kg	72-55-9	9	2.9 U	3.8 U
4,4'-DDD	µg/Kg	72-54-8	16	1.3 U	17 U
4,4'-DDT	µg/Kg	50-29-3	34	7.0 U	3.8 U
alpha-Chlordane	µg/Kg	5103-71-9	-	0.65 U	1.9 U
gamma-Chlordane	µg/Kg	5103-74-2	-	5.8	17
Aroclor 1016	µg/Kg	12674-11-2	-	NA	38 U
Aroclor 1242	µg/Kg	53469-21-9	-	NA	38 U
Aroclor 1248	µg/Kg	12672-29-6	-	65 U	38 U
Aroclor 1254	µg/Kg	11097-69-1	-	73	230
Aroclor 1260	µg/Kg	11096-82-5	-	110 J	190 U
Aroclor 1221	µg/Kg	11104-28-2	-	91 U	76 U
Aroclor 1232	µg/Kg	11141-16-5	-	52 U	38 U
Total PCBs	µg/Kg	1336-33-3	300	183	230
Metals					
Antimony	mg/Kg	7440-36-0	150	5.1 J	50.4 J
Arsenic	mg/Kg	7440-38-2	57	8.7	10.8
Cadmium	mg/Kg	7440-43-9	5	0.34 U	0.73 U
Chromium	mg/Kg	7440-47-3	-	981	315
Copper	mg/Kg	7440-50-8	390	33.2	73.2
Lead	mg/Kg	7440-92-1	450	61.2	198
Mercury	mg/Kg	7440-97-6	1	0.08	0.17
Nickel	mg/Kg	7440-02-0	140	27.6	16.2
Silver	mg/Kg	7440-22-4	6	0.07	0.58 U
Zinc	mg/Kg	7440-66-6	410	68.8 J	272

Notes:

-	No standard.
J	Associated value is estimated.
PCBs	Polychlorinated Biphenyls.
SQO	Sediment Quality Objective.
	Concentration is greater than the SQO.

APPENDIX B

SAMPLING AND ANALYSIS PLAN

TABLE OF CONTENTS

LIST OF FIGURES
(Following Appendix)

LIST OF TABLES

LIST OF ATTACHMENTS

1.0 INTRODUCTION

The Port of Tacoma (POT) and Occidental Chemical Corporation (OxyChem) are cooperatively conducting a preliminary characterization of the bank and side-slope areas adjacent to the Navy and Marine Corps Reserve property located on Alexander Avenue in Tacoma, Washington. This work is being performed as part of the Phase I Hylebos Mouth Cleanup.

The purpose of this preliminary characterization is to assess the chemical and physical characteristics of the bank and side-slope areas and determine whether active remediation is needed.

The field procedures and sampling methods detailed in this document are Site-specific and have been prepared for the Navy Bank Area Characterization.

All sampling activities shall be conducted in accordance with the protocols detailed in the project Sampling and Analysis Plan (SAP), Quality Assurance Project Plan (QAPP), and Health and Safety Plan (HSP).

1.1 SITE LOCATION

The Navy and Marine Corps Reserve property (the Property) is located along the Hylebos Waterway at 1100 E. Alexander Avenue in Tacoma, Washington. The bank and side-slope adjacent to the Property between the elevations of 11 feet mean lower low water (MLLW) and -30 feet MLLW are collectively referred to as the Navy Bank. The location of the Navy Bank is shown on Figure B1.1.

1.2 BACKGROUND

In 1994 and 1998, during the Hylebos Waterway Pre-Remedial Design Program (Hylebos PRD) conducted by the Hylebos Cleanup Committee (HCC), two samples of sediment from the vicinity of the Navy Bank were collected and analyzed. The samples collected were from the intertidal and subtidal zones. The samples were collected at elevations of approximately 0 feet MLLW and -10 feet MLLW, respectively. The locations of these samples are shown on Figure B1.2.

The Hylebos PRD samples were analyzed for the constituents listed in Table 2.1 of the Work Plan. The results of the analyses of these two samples are contained in

Appendix A of the Work Plan. In the intertidal zone (between the elevations of 11 feet MLLW and 0 feet MLLW), the only chemical compound detected at a concentration which exceeded the Sediment Quality Objectives (SQOs) was ethylbenzene. In the subtidal zone (between the elevations of 0 feet MLLW and -30 feet MLLW), the compounds with concentrations which exceeded the SQOs were semi-volatile organic compounds (SVOCs) including polynuclear aromatic hydrocarbons (PAHs).

2.0 SAMPLE COLLECTION

Sediment samples will be collected and analyzed for the characterization of chemical and physical properties. The sampling program is described in Sections 3.0 and 4.0 of the Work Plan. A sample collection and analysis summary is presented in Table B2.1.

Sample locations will be accessed by foot either from the bank or boat, or by using a small boat. The sample analyses, required sample volumes, and sample containers are listed in Table B2.2.

Sampling personnel will wear a new pair of disposable nitrile gloves at each sampling location or depth. Sampling equipment will be decontaminated prior to commencement of work and between sample locations in accordance with the procedures presented in Section 5.0.

2.1 BANK SAMPLES

Bank samples will be collected by hand at an appropriate tide using pre-cleaned stainless steel utensils. The depth of sampling for the bank samples will be 0 to 10 centimeters (cm).

Samples will be collected from four locations within each of the four bank grid sections. At two locations within each grid section two samples will be collected; one sample will be collected for discrete volatile organic compound (VOC) analyses and one sample will be composited with the other grid section samples for analyses of the remaining parameters. A total of 16 grab samples (four from each grid section) will be collected for preparation into four analytical samples. Samples will be collected where significant sediment deposits are located and will be representative of the general bank condition. Sampling will be performed in accordance with the procedure described below.

1. Locate the proposed sampling location.
2. Where VOC samples are to be collected, first collect sediment directly into labeled, laboratory provided glassware for VOC analyses. VOC sample containers will be filled completely and capped with no headspace. Immediately place the VOC sample in a cooler on ice.
3. Following collection of the VOC sample, collect the remaining sample volume into a precleaned stainless steel bowl.

4. After sufficient volume of sediment is obtained, cover the bowl and store in a cooler on ice. Samples from within a grid section will be composited and homogenized as described in Section 3.1.

5. Following completion of sample collection, mark the sample location and record all field book entries.

Proceed to the next sampling location.

2.2 SIDE-SLOPE SAMPLES

Side-slope samples will be collected using a precleaned van Veen sampler or Eckman dredge. The depth of sampling for the side-slope samples will be 0 to 10 cm. Sample locations will be accessed from the dock or from a small boat. The sampler will be lowered and retrieved by hand.

Samples will be collected from two locations within each of the four side-slope grid sections. At one location within each grid section two samples will be collected; one sample will be collected for discrete VOC analyses and one sample will be composited with the other grid section samples for analyses of the remaining parameters. A total of 8 grab samples (two from each grid section) will be collected for preparation into four analytical samples. Samples will be collected from each of the side-slope locations as described below.

1. Locate the proposed sampling location.
2. Lower and retrieve the sampler.
3. At locations where VOC analyses are to be performed, remove sediment from the sampler and place directly into labeled, laboratory provided glassware for VOC analyses. VOC sample containers will be filled completely and capped with no headspace. Immediately place the VOC sample in a cooler on ice.
4. Following removal of the VOC sample, place the remaining sample into a precleaned stainless steel bowl. If the volume of the remaining sample is insufficient for the analyses required, collect additional sample.
5. After sufficient volume of sediment is obtained, cover the bowl and store in a cooler on ice. Samples from within a grid section will be composited and homogenized as described in Section 3.1.
6. Measure and record the depth of the water column at the sample location.
7. Record all field book entries.

8. Proceed to the next sampling location.

3.0 SAMPLE PROCESSING

3.1 SAMPLE HOMOGENIZATION

Samples will be retrieved and handled as described in Section 2.0 prior to homogenization. Homogenization will then proceed as described below.

A clean pair of disposable nitrile gloves will be used to handle each sample.

All bowls and utensils used for sample homogenization will be decontaminated before use and between samples according to the procedures presented in Section 5.0.

All non-VOC samples collected within a grid section will be placed into a precleaned stainless steel bowl for homogenization. To the extent possible, standing water will be drained off the sample prior to compositing and homogenization. Samples will be homogenized by mixing using precleaned spoons until the sample appears uniform in color and texture. Sufficient sample for the analyses required will be taken from the bowl and placed directly into precleaned sample jars provided by the analytical laboratory. Care will be taken to avoid including large pieces of gravel or debris in the analytical sample.

3.2 LABELING AND PACKAGING

A unique sample numbering system will be used to identify each analytical sample. This system will provide a tracking number to allow retrieval and cross-referencing of sample information. The sample numbering system to be used is described as follows:

Example: SE-121695-AA-XXX;

- SE: Designates sample type (sediment);
- 121695: Date of collection (mm/dd/yy);
- AA: Sampler initials; and
- XXX: Unique sample number.

QC samples will also be numbered with a unique sample number.

Sample containers will be individually wrapped and placed on ice or cooler packs in laboratory-supplied coolers immediately after labeling. Samples will be delivered to the laboratory by courier under approved Chain of Custody procedures as described below.

3.3 CHAIN OF CUSTODY PROCEDURES

Chain of Custody forms will be completed for all samples to document the transfer of sample containers. Custody seals will be placed on each cooler. The cooler will then be sealed with packing tape. Sample container labels will include sample number, place of collection, and date and time of collection. All samples will be refrigerated using wet ice at 4°C (±2°C) and delivered to the analytical laboratory within 48 hours of collection. All samples will be delivered to the laboratory by commercial courier or contractor personnel. All samples will be maintained at 4°C (±2°C) by the laboratory.

The Chain of Custody record, completed at the time of sampling, will contain, but not be limited to, the sample number, date and time of sampling, and the name of the sampler. The Chain of Custody document will be signed, timed, and dated by the sampler when transferring the samples. A typical Chain of Custody form is shown on Figure B3.1.

Each sample cooler being shipped to the laboratory will contain a Chain of Custody form. The Chain of Custody form will consist of four copies which will be distributed as follows: the shipper will maintain a copy while the other three copies will be enclosed in a waterproof envelop within the cooler with the samples. The cooler will then be sealed properly for shipment. The laboratory, upon receiving the samples, will complete the three remaining copies. The laboratory will maintain one copy for their records. One copy will be returned to the Quality Assurance/Quality Control (QA/QC) Officer-Field and Analytical Activities upon receipt of the samples by the laboratory. One copy will be returned with the data deliverables package.